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Los Angeles-Orange County Metropolitan Area Project, Whittier, CA

Prepared for

Environmental Protection Agency, San Francisco, CA Region IX

Aug 79

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LA/OMA PROJECT

MARKETING PROGRAMS DESIGNED FOR SLUDGE MANAGEMENT

- MARKETS FOR SLUDGE PRODUCTS WITH MARKETING STRATEGY
- POTENTIALLY MARKETABLE SLUDGE PRODUCTS
- EXISTING AND PAST SLUDGE MARKETING EXPERIENCES

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The LA/OMA Project is to develop a long term plan, including an implementation strategy to re-use/dispose of residual solids resulting from industrial and municipal wastewater treatment in the Los Angeles/Orange County Metropolitan area.

This report presents a marketing strategy for sludge disposal. Three separate studies by marketing consultant, Gruen Gruen + Associates comprise this report. "Markets for Sludge Products" identifies product features important to the market served, potential sales, revenue, and characteristics of a successful program. "Potentially Marketable Sludge Products" list sludge-based products whose marketability warrant further investigation. "Existing and Past Sludge Product Marketing Experiences" assesses current practices of two participating agencies and communities outside the study area.

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Gruen Gruen + Associates

Participating Agencies
U.S. Environmental Protection Agency (Region IX)
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City of Los Angeles
Los Angeles County Sanitation Districts
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LA/OMA PROJECT

PARTICIPATING AGENCIES

Environmental Protection Agency (EPA)
State Water Resources Control Board (SWRCB)
County Sanitation Districts of Los Angeles County (LACSD)
County Sanitation Districts of Orange County (OCSD)
City of Los Angeles (CLA)

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FOREWORD

One of the long term goals of the sludge management program indicated for the LA/OMA area is stated as:

> *Socially, economically, and environmentally cost effective RECOVERY OF RESOURCES from wastewater sludges.*

The specification of resource recovery in this manner emphasizes the public's and Project's support for recycling sludge. A marketing strategy is essential to complete the cycle of a responsible sludge management program: solids capture, treatment, conversion to a usable product, and "a marketing strategy to distribute the product(s) for reuse".

The strategies discussed in this report were designed primarily to complement composting sludge management alternatives with specific processing locations. Other uses for wastewater solids were considered and discussed including energy recovery.

The LA/OMA engineering, environmental and implementability evaluations of alternatives led to the definition of a sludge program that combines the processes of composting, energy recovery and landfilling. The program is designed to "phase implementation", meaning that alterations to the processes (including the deletion of any or addition of new systems) are possible after several years of initial operation and monitoring.

The composting portion of the sludge management program has incorporated the conclusions/recommendations of the marketing studies. In the late 1980's, a daily production of 150 to 200 tons of humus will be distributed primarily to the "specialty" and "home and garden" markets. This places emphasis on sludge used in urban ornamental landscaping, with less emphasis on its use in agricultural applications.

This strategy was based upon the product of three separate studies by marketing consultant, Gruen Gruen & Associates. The most recent of these studies makes up the body of this report: "Markets for Sludge Products", which concludes with a recommended marketing strategy. The other supporting segments are: "Potentially Marketable Sludge Products" and "Existing and Past Sludge Marketing Experiences". The latter two are included as Sections 2 and 3.

With regard to sludge management planning overall, considering social, environmental and economic costs along with marketability, LA/OMA Project is currently preparing the necessary environmental documents to complete the study phase. The participating agencies will proceed to develop design specifics for the individual facilities, and eventually begin construction. The composting, energy recovery and landfilling systems are expected to be in operation in the mid - to late - 1980's.

For more information about LA/OMA Project, interested persons should call or write at: (213)699-7411: P.O. Box 4998, Whittier, California 90607.

REGIONAL WASTEWATER SOLIDS MANAGEMENT PROGRAM

LOS ANGELES/ORANGE COUNTY METROPOLITAN AREA

LA/OMA PROJECT

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CHAPTER 1

INTRODUCTION

CONTEXT OF THIS REPORT

The purpose of the LA/OMA Project is to develop a long-term sludge management plan for the study area, which includes the urbanized areas of Los Angeles and Orange counties. The study began by developing descriptions of sludge processing and disposal or use projects which might be studied. Engineering, marketing, environmental and public acceptance evaluations of these potential projects were prepared and used to identify the most promising projects. Research into the feasibility, cost and acceptability has been focused on these most promising projects. Upon completion of this in-depth research, decisions will be made as to which project or projects to pursue and how much of the study area's sludge could be handled by each. Implementation of the project or projects will begin after appropriate public review.

Gruen Gruen + Associates is the marketing consultant to the LA/OMA Project. The marketing element of the study has been divided into four tasks. The first two tasks provided information which assisted project staff in screening the list of projects to eliminate those not promising enough to be worthy of detailed analysis. The Task One report identified and described current and past sludge product marketing efforts in southern California and elsewhere in the nation. The goal of this report was to identify the key factors which appeared to determine the ultimate success or failure of past and present marketing programs. The Task Two report then linked sludge products, uses and users for all projects potentially involving marketing. In this report information developed for the Task One report and by other LA/OMA consultants was analyzed in order to identify the apparent likelihood of success of marketing projects involving various combinations of products, uses and users.

This Task Three report is the result of extensive research and analysis of those marketing projects which survived the screening process. This report identifies the product features important to the markets which might be served, quantifies potential sales and revenue and describes the characteristics which will determine the long-run success of a marketing program. This report will assist the LA/OMA Project staff in selecting the marketing project which will become part of the area's sludge management plan. Once this selection is made, project staff and area wastewater treatment agencies will develop the specific measures necessary to implement the sludge marketing program selected by the project.

PURPOSE AND ORGANIZATION

In the Task Two effort, Gruen Gruen + Associates discerned three distinct markets for a sludge product. The vast differences discerned in the characteristics of demand in each of these markets clearly indicated that each must be studied separately.

The first market described in this report (Chapter 3) is the home and garden market which consists of all the households in the LA/OMA Project study area. The Task Two report described this market as potentially the most promising in terms of cost-effectiveness, reliability, compatibility with existing technology and potential environmental and health impacts.

The second market dealt with in this report (Chapter 4) has been called the specialty market. It consists of a wide variety of users generally located within the urban area and engaged in landscape construction or maintenance or plant propagation. Users include landscape architects and contractors, public agencies, wholesale nurseries and others. Two reasons for studying this market can be found in the Task Two report. First, it was noted that large volumes of soil amendments, primarily wood by-products, are consumed by this market. Second, other uses of those wood by-products, such as energy conversion, are beginning to bid wood by-products away from soil amendment users, indicating a favorable competitive situation for a sludge product in the specialty market.

The third market (Chapter 5) actually consists of two area-specific agricultural markets - the Barstow area and the Antelope Valley. While the Task Two report indicated that agricultural markets for sludge products were generally not promising, it was noted that areas with particularly sandy soils, particularly where active manure trades currently existed, would be the most attractive agricultural markets. Since the LA/OMA Project staff is considering an alternative involving transporting sludge (probably by pipeline) out of the urban area for processing and use or disposal, Gruen Gruen + Associates was asked to study the agricultural markets in the vicinity of potential processing sites.

The first goal of the Task Three effort was to develop quantitative estimates of the demand for a sludge product at various prices within each of these markets and the resulting revenue the wastewater treatment agencies producing the sludge product could expect to receive. This information will assist the LA/OMA staff in making the trade-offs necessary to develop a long-term sludge management program incorporating the most advantageous combination of marketing strategies and other sludge use and disposal alternatives. It should be noted that all prices mentioned in the report are effective mid-1978 when the bulk of the research was conducted.

The second, but no less important, purpose of this study was to develop enough information regarding the characteristics of demand to be able to understand what steps would be necessary to successfully implement a marketing program. Chapters 3 through 5 deal with such important factors as the elasticity of demand with regard to price exhibited by each of the markets, the potential that advertising and education could expand the demand for sludge products and the types of pricing policies which would maximize sales and agency receipts over the long run. Chapter 6 draws from the previous three chapters to deal with the choice of an overall marketing strategy. That chapter discusses concerns including the importance of establishing appropriate incentives in a marketing contract, the need to encourage investment in advertising and promotion aimed at differentiating the sludge product from other products and the critical need to maintain separation between the various markets being served.

CHAPTER II

CONCLUSIONS

CHAPTER 2

CONCLUSIONS

THE MAGNITUDE AND CHARACTERISTICS OF DEMAND

Estimates of the potential annual sales of a sludge product and resulting revenues to the producing agency at various sales prices are shown in Table 2.1. The two most important numbers in each case are the potential sales and resulting revenue to the producer; however, the price at which the product is sold determines both. Price is a key variable and is discussed throughout the report.

The estimates of potential sales shown in Table 2.1 range from 99,300 tons under the assumption the product is given away, to 48,800 tons at a $2.00/40-lb. bag price. These tonnages represent the estimated maximum attainable sludge product sales in this market. Attainable sales were estimated at 75% of the intrinsic demand for sludge products in this market. Estimates of intrinsic demand in 1990, shown in Chapter 3, range from 132,400 tons to 65,000 tons.

Two prices were tested for the specialty market; $9.00 and $5.50 per cubic yard. Table 2.1 indicates that the $3.50 drop in price induces an approximately six-fold increase in volume; that is, the anticipated sales volume at $9.00 per cubic yard is only 23,800 tons, but rises to 145,100 tons at $5.50 per cubic yard.

Only one price was considered for the area-specific agricultural markets in the Antelope Valley and Barstow area - which were studied in this effort. At a $9.40 per ton price, Antelope Valley growers were estimated to be willing to purchase between 37,000 - 64,600 tons annually. This estimate was based on 1976 crop acreages, since crop acreages could not be accurately projected beyond 1982 in this area. Demand in the Barstow area was estimated at between 127,400 - 169,800 tons annually by 1990 at $5.00 per ton.

The deviations of these price and volume estimates are explained in Chapters 3 through 5. The demand in sludge products in each market should be visualized as a curve on a chart where price is on one axis and volume on the other. The curves for the various markets analyzed differ from one another and generally are neither straight lines nor smooth curves. They typically have kinks at various significant price levels and differ dramatically in respect to their demand elasticities or the degree to which a drop in price induces a change in the amount of the product demanded.

TABLE 2.1

PROJECTED ESTIMATES OF POTENTIAL 1990 SLUDGE PRODUCT SALES AND REVENUES BY MARKET

	Lower Price	Intermediate Price	Higher Price
The Home and Garden Market			
Prices Tested	Free of Chg.	$1 per 40 lb. bag	$2 per 40 lb. bag
Sales at Each Price	99,300 tons	86,900 tons	48,800 tons
Agency Revenue at Each Price	($4,915,400)-($3,922,400)	($1,173,200)-($1,086,300)	$0 - $97,000
The Specialty Market			
Prices Tested	$5.50 per cu. yd.		$9.00 per cu. yd.
Sales at Each Price	145,100 tons		23,800 tons
Agency Revenue at Each Price	($174,100)-$0		$0-$42,800
The Agricultural Markets			
The Antelope Valley			
Prices Tested		$9.40 per ton	
Sales at Each Price		37,000-64,600 tons*	
Agency Revenue at Each Price		$7,400-$142,100	
The Barstow Area			
Prices Tested		$5.00 per ton	
Sales at Each Price		127,400-169,800 tons	
Agency Revenue at Each Price		($203,800)-$135,800	

SOURCE: Gruen Gruen + Associates

*Based on 1976 crop acreages, it was not possible to project the Antelope Valley market beyond 1982.

The specific prices shown in Table 2.1 were chosen to portray major pricing strategy options (i.e., to be close to the kinks in the demand curves). In the home and garden market, the $2/bag price approximates the pricing strategy followed by the Kellogg Supply Company in this market, while the $1 and zero prices were tested to assess the potential to increase sales by lowering the price. In the specialty market the Kellogg Supply Company is currently marketing its product at about $9/cubic yard, the higher price used in this analysis. The $5.50 price represents the average price at which wood by-products are sold. Wood by-products currently dominate the specialty soil amendment market. Only one price competitive with the price of comparable products is shown for the agricultural markets. It was found that significant proportions of the agricultural market could not be captured at higher or lower prices because demand for these site-specific agricultural uses is relatively inelastic (therefore not substantially greater) at prices above and below those competitive with comparable products.

The home and garden demand estimates represent the maximum attainable sales for a sludge product. Maximum attainable sales are estimated at 70-80% of demand. The ability of a specific product and marketing program to achieve even 70-80% penetration will depend primarily on the packaging and labeling (including brand name and any warnings) of the product, its texture, degree of odor and its visual effect. Home and garden users are generally less aware of the more subtle characteristics of the product, but they will object to a product with more than 25-30% water content. The demand estimates for this market assume the product will not have a greater water content.

Regarding labeling, it was found that a sample health warning label would reduce home and garden demand by about 16%.

Specialty market users are more concerned with the characteristics of the product than home and garden users. In order to be able to achieve the potential estimated sales at a given price in this market, the product must generally be: of uniform particle size; sterile; low in salts; low in heavy metal content; of a texture which retains moisture but does not solidify quickly; a consistent quality; readily available; and delivered to the user's project site. Wholesale nurseries are even more sensitive to the salt and heavy metal content of the product than the majority of specialty users.

The sample health warning tested in the home and garden market would not likely heavily impact the specialty market demand. The addition of lime to the product, another possible health-related measure, could have an impact on wholesale nursery users, but is not expected to have a significant impact on other components of the specialty market. The specialty market demand estimates also incorporate users' preferences for a product which does not exceed 15% water content. The importance of these product characteristics was first discerned in previous sludge marketing studies conducted by Gruen Gruen + Associates and confirmed in the research for this study.

Antelope Valley growers require that the product have a consistent phosphorous content of about 2.5%, that the product be sold on a delivered and spread basis and that its use not be severely limited by regulations associated with its heavy metal content. Barstow area growers simply require a material of uniform particle size and low heavy metal content sold on a delivered basis. Growers in both areas actually prefer a material with approximately 20-40% water content. All demand estimates shown on Table 2.1 are based on the product including the water content acceptable in each market. In order to estimate the demand for sludge products in each market on a dry tonnage basis, the demand estimates in Table 2.1 for the agricultural markets would have to be reduced by about 30%, while those for the home and garden and specialty markets would have to be reduced by about 12.5%.

Certain characteristics of the marketing systems established to serve each market will determine their potential to maximize sales in the long run. In all markets it was found that the most effective system would include the sewage treatment agency or agencies as producer of the basic sludge product and a single private marketing firm to serve each market. While different firms could be engaged to serve the different markets, this could make it more difficult to maintain market separation except perhaps for the agricultural markets and, at the least, would require much more cummunicative and monitoring effort on the part of the producer(s). The relationship established with the marketing firm must include appropriate incentives to induce the marketing firm to undertake the needed effort to maximize long-term sales in each market served. In the home and garden market significant packaging, sales and advertising efforts are required. In the specialty and agricultural markets, ongoing sales/service programs and ready availability are required.

THE CHOICE AND IMPLEMENTATION OF A MARKETING PROGRAM

Overall marketing programs may vary in terms of the markets to be served and the volume and price goals to be pursued. A strategy aimed at maximizing sales could generate sales equal to over 100% of the potential 1990 LA/OMA sludge production, while one aimed at maximizing producer returns could generate sales equal to only 27% of potential 1990 production.

The cost per unit of sludge sold or disposed of will be a prime consideration in identifying a desirable overall marketing and/or disposal program. This makes the elasticity of demand an important factor as the high elasticity of the specialty market may make it attractive to pursue a low pricing strategy in that market to increase sales and to pursue exactly the opposite strategy in the home and garden market, due to the inelasticity of its demand in the price range analyzed. The location of the production facilities will also be important as an urban location will result in high transport costs to serve the agricultural markets and vice versa. Finally, the potential to shift the demand curve of the home and garden market through a marketing program aimed at differentiating the LA/OMA sludge product from other soil amendments indicates the value of a high pricing strategy in this market, while the lack of probable benefits of a similar program in the specialty market favors a lower pricing strategy in the specialty market.

The long-term success of the implementation of a sludge product marketing program will depend on the careful maintenance of separation between the various markets being served because of the important differences in the marketing efforts required to maximize long-term sales in each. Success will also depend on the producing agency's ability to establish a contractual relationship embodying the necessary incentives with a marketing firm that is fully committed to undertaking an involved and sophisticated marketing effort.

CHAPTER 3

THE LA/OMA HOUSEHOLD MARKET

INTRODUCTION

THE NEED TO LOOK AT THE HOME AND GARDEN MARKET

The home and garden market differs in the packaging, pricing, promotion and distribution of planting materials from the professional/specialty and agricultural markets. The literature contains few studies and articles on the marketing of sewage sludge plant nutrient and soil conditioner products to this market. The three primary research efforts include the Urban Services Group's interim and draft final report Market Study for Composted Sewage Sludge in the Metropolitan Washington Area, prepared in 1976 for the Metropolitan Washington Council of Governments, and Marketing Report Phase II which Gruen Gruen + Associates submitted to the San Francisco Bay Region Wastewater Solids Study in April 1977, and the report on The Marketability of Heat-dried Sewage Sludge in Portland submitted by Gruen Gruen + Associates to the U. S. EPA Region X in June 1978.

The key prerequisite for any reasonably accurate description and forecast of the potential future household use of a sewage sludge product is dependent upon the ability to forecast the behavior of those persons residing in existing housing units. Households residing in existing structures, not in newly constructed homes, are the target market since newly constructed dwelling units seldom account for much more than 2% of the total housing stock in any one year. The percent of newly constructed housing in the LA/OMA market area was approximately 2.3% per year for the 1970-75 time period. Therefore, a great deal of the analytical results are based upon the findings of field research with potential consumers residing in Los Angeles and Orange Counties. Interviews with a random sample of these households provided insights into their present purchase patterns, attitudes toward and likely responses to the availability of a heat-dried or -composted sewage sludge planting material product.

The chapter is organized into four sections of which this introduction comprises the first. The following section discusses the method used to randomly sample households in the study area and compares the outcome of the sampling with distribution of households indicating no use of outdoor and indoor planting materials is also described in this section. The third section describes the current use of planting materials including the types of materials purchased, the volume of each type purchased and the types of establishments at which purchases were made. This section also discusses the penetration of this market by an existing line of sludge products produced by the Kellogg Supply Company. The final section is devoted to estimates of the expected use of product per household and overall. The potential impacts regulations resulting from concerns with regard to health impacts could have on the demand estimates are discussed, then key aspects of the marketing system necessary to serve the estimated demand. The section and chapter conclude with an estimate of the sales revenue the producing agency could expect to receive under various circumstances.

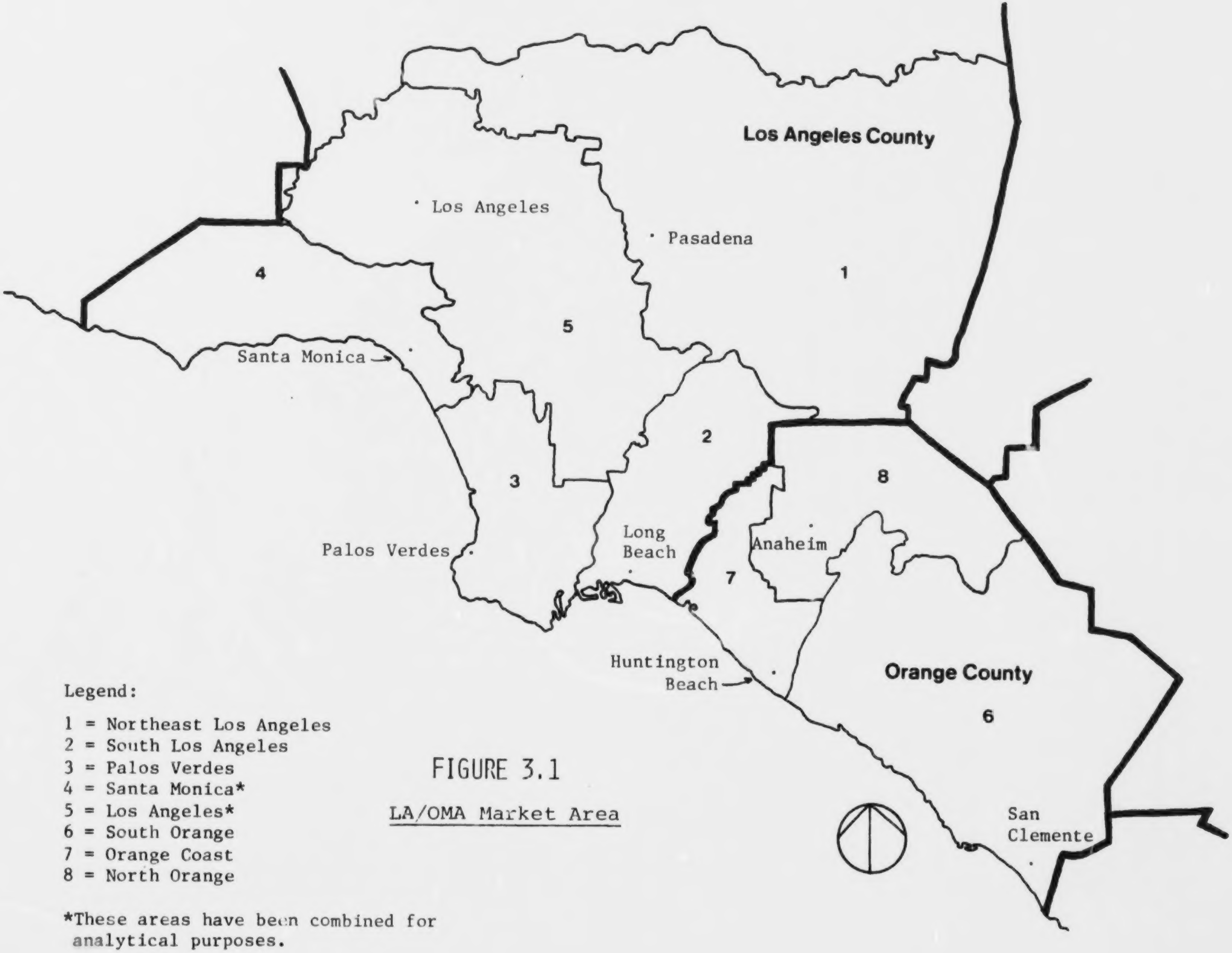
THE LA/OMA HOUSEHOLD SURVEY

A RANDOM SAMPLE OF LA/OMA HOUSEHOLDS

Figure 3.1 depicts the geographic boundaries of the LA/OMA primary market area from which a random sample of 563 households was selected. A sample size of 563 provides a greater than ± .05 but less than a ± .04 error estimate at a 95% confidence coefficient level assuming a zero nonresponse rate. The error estimate differs for each question. Where total numerical responses differ, the smaller the number, the larger the error estimate. For example, the 446 households surveyed in Los Angeles County provided a ± .05 error estimate, but the 117 Orange County subsample resulted in an error estimate of > ± .08. These households were surveyed by telephone during the first and second weeks of January, 1978. Respondent households within the delineated market area were selected randomly with the use of the Gruen Gruen + Associates (GG+A) Random Digit Dialing (RDD) program. The appropriate county prefixes were inserted exogenously with the use of prefix listings provided by the Pacific Telephone and General Telephone Companies. The RDD program then randomly generated the last four telephone digits.

The RDD process generates numerous ineligible telephone numbers. Ineligibility arises from many sources including disconnects, nonresidential numbers such as businesses, institutions, telephone booths and residential numbers of households located outside the study area.

Of the 563 completed questionnaires, approximately one half were conducted with the original designated respondent and the other half with a substituted household respondent. Substitutions of eligible numbers are also made for many reasons. The primary one is the respondent's unwillingness to participate in the study. This, in turn, may be due to illness, language difficulties or disinterest. Two of the interviewers were bilingual so that Spanish-speaking respondents could participate in the survey. Sixty-nine of the 281 substitutions were numbers that could not



Legend:

1 = Northeast Los Angeles
2 = South Los Angeles
3 = Palos Verdes
4 = Santa Monica*
5 = Los Angeles*
6 = South Orange
7 = Orange Coast
8 = North Orange

*These areas have been combined for analytical purposes.

FIGURE 3.1

LA/OMA Market Area

be reached after three callbacks. The actual eligibility of these numbers can not be determined. To reduce the occurrence of excluding the more busy household from the survey, callbacks were conducted at different times of the day and on different days of the week. The average questionnaire took 10 to 15 minutes to administer. A more complete description of the survey methodology and a copy of the questionnaire can be found in Appendices A and B.

A COMPARISON OF THE GG+A SAMPLE DISTRIBUTION WITH THE SCAG MODIFIED BASELINE POPULATION FORECAST

Figure 3.1 divides the LA/OMA two-county market area into a combination of eight Southern California Association of Governments (SCAG) regional statistical areas (RSA's). This permits a comparison of the SCAG 1975 modified population forecast with the regional distribution of the GG+A sample households. (The SCAG 1976 growth forecast policy was adopted by the Executive Committee in December 1975 and is projected in five-year increments from 1975 to 2000.) Table 3.1 presents the SCAG household forecast for Los Angeles and Orange Counties by subgrouping (groupings of RSA's) for 1975-1990. The SCAG forecast is primarily a "quantitative forecast guide". This means that historic trends may be modified by the policy objectives of local and regional planners and public officials.

A comparison of the GG+A 1977 LA/OMA sample households with the 1975 SCAG baseline forecast by eight subregions is shown in Table 3.2. The two differ by 1% to 3% for each of the eight subareas. Seventy-nine percent of the LA/OMA household sample resided in Los Angeles County, while 81% of the 1975 SCAG households were forecast to reside there. It is not known whether the observed differences are due to errors in the population forecast, sampling errors, or to actual population shifts that may have taken place in the subregions. It could, of course, be some combination of the above three.

The magnitude of the difference does not appear so great as to warrant concern that the LA/OMA region's households have not been adequately represented. On the other hand, it does suggest the use of larger spatial groupings as a basis for estimating the demand for a sewage sludge planting material product. While the following discussion points out that significant differences exist among the eight areas with regard to the care of plantings, the estimates of planting material use and demand for sludge products will only be disaggregated by county rather than the eight areas.

TABLE 3.1
HOUSEHOLD FORECAST FOR LOS ANGELES AND ORANGE COUNTIES BY SUBREGIONS FOR 1975-1990

Areas	1975	1980	1985	1990
Area 01 RSA 11, 25, 26, 27, 8, 9, 10	486,101	511,400	540,100	568,300
Area 02 RSA 20, 22	378,913	396,600	415,000	433,400
Area 03 RSA 18, 19	346,804	360,400	375,500	390,500
Area 04 RSA 7, 15, 16	158,732	170,200	178,900	187,300
Area 05 RSA 12, 13, 14, 17, 21, 23, 24	1,324,847	1,362,900	1,415,300	1,467,700
Los Angeles County	2,695,397	2,801,500	2,924,800	3,047,200
Area 06 RSA 39, 40, 42, 43, 44	267,908	337,200	384,700	432,000
Area 07 RSA 35, 38	152,915	171,500	185,700	199,800
Area 08 RSA 36, 37, 41	202,208	219,000	241,700	264,400
Orange County	623,031	727,700	812,100	896,200
Los Angeles and Orange Counties	3,318,428	3,529,200	3,736,900	3,943,400

SOURCE: Southern California Association of Governments, Regional Population, Housing, Employment and Land Use Forecasts: Baseline and Range, Volume I, 1977 (Table III-2).

TABLE 3.2
COMPARISON OF GG+A 1977 SURVEYED HOUSEHOLDS AND 1975 SCAG BASELINE FORECAST* BY SUBREGION

	GG+A 1977 Surveyed Households	SCAG 1975 Forecast Households	Difference
	%	%	
Area 01 Northeast L.A. County	12	15	+ 3
Area 02 South L.A. County	10	11	+ 1
Area 03 Palos Verdes	11	10	- 1
Area 04 Santa Monica	2	5	+ 3
Area 05 City of Los Angeles	43	40	- 3
Area 06 South Orange	7	8	+ 1
Area 07 Orange Coast	7	5	- 2
Area 08 North Orange	7	6	- 1
% Total	99	100	

SOURCE: Southern California Association of Governments, Regional Population, Housing, Employment and Land Use Forecasts: Baseline and Range, Volume I, 1977, pp. 14-16 (Table III-2) and Gruen Gruen + Associates, LA/OMA Survey, January 1978.

*The SCAG forecast is primarily a quantitative forecast guide used to direct desirable growth. "The forecast takes into account historic trends with which they may differ or coincide, depending on policy, and the assumptions and projections of national forecasters, planners, demographers and institutions in the region." Nineteen seventy-five is used as the baseline projection year and is derived from the SCAG 1976 modified population forecasts.

SUBREGIONAL DIFFERENCE IN THE CASE OF INDOOR AND OUTDOOR PLANTINGS

The questionnaire was designed to terminate, as quickly as possible, interviews with those households which do not have the responsibility for taking care of either indoor or outdoor plantings. Information concerning whether the household took care of indoor and outdoor plantings, along with the household's geographic location, type and ownership status of their primary residence and the sex of the respondent was obtained in the first seven questions. Approximately 23% of the sample households were terminated at this point because they claimed no one in their household took care of either indoor or outdoor plantings. This statistic includes households who indicated they turn this responsibility over to a gardener or gardening service. Such households are highly unlikely to buy any planting materials. As Table 3.3 points out, there are major subregional differences as to the proportion of households claiming no responsibility. Those respondents residing in the City of Los Angeles (area 05) have a far lower proportion stating a responsibility for the care of their outdoor lawn and plantings than do those who live in area 01 or those communities located northwest of Los Angeles. {The 12 area 04 (Santa Monica) respondent households have been combined with the area 05 (City of Los Angeles) households in order to create more adequately sized analytical subgroupings. The error estimate of the 12 household subgroupings is too large to be analytically meaningful.} This finding can be partially explained by the fact that 56% of the area 05 households live in single-family structures, while 80% of the area 01 households do likewise. Table 3.4, which shows the households' responses to the care of indoor plants by subregion, indicates that only 57% of the City of Los Angeles (area 05) households claim responsibility for the care of indoor plants, while 65% of those households residing in area 01 state that they care for indoor plants. The Orange County sample households, as a whole, were more likely to care for both indoor and outdoor plantings than were the Los Angeles County respondent households. This is because the City of Los Angeles (area 05) accounts for such a large proportion of that county's total sample households.

The nonparametric chi square test of significance was used to test if the null hypothesis (that there is no statistical difference between crosstabulated groupings) could be rejected at or greater than the .05 probability level. The obtained chi square in Tables 3.3 and 3.4 were both statistically significant. This statistic will be used as an analytical tool and its significance level reported upon in the subsequent discussion of the key survey variables.

TABLE 3.3
CARE FOR OUTDOOR PLANTINGS BY SUBREGION

Combined RSA's	Yes		No		Gardner or Gardening Service		Total	
	#	%	#	%	#	%	#	%
Area 01 N.E. L.A. County	53	77	12	17	4	6	69	100
Area 02 South L.A. County	39	67	17	29	2	3	58	99
Area 03 Palos Verdes	40	64	21	34	1	2	62	100
Area 05 City of Los Angeles and Santa Monica	130	51	114	44	12	5	256	100
Area 06 South Orange	28	68	11	27	2	5	41	100
Area 07 Orange Coast	25	64	14	36	0	0	39	100
Area 08 North Orange	26	68	11	29	1	3	38	100

χ^2 = 26.436 with 12 degrees of freedom, significant = .0093.

SOURCE: GG+A's LA/OMA Household Survey, January 1978

TABLE 3.4
CARE FOR INDOOR PLANTS

Combined RSA's	Yes		No		Total	
	#	%	#	%	#	%
Area 01 Northeast L.A. County	45	65	24	35	69	100
Area 02 South L.A. County	42	72	16	28	58	100
Area 03 Palos Verdes	36	58	26	42	62	100
Area 05 City of L.A. and Santa Monica	147	57	109	43	256	100
Area 06 South Orange	32	78	9	22	41	100
Area 07 Orange Coast	31	80	5	20	36	100
Area 08 North Orange	25	66	13	34	38	100

χ^2= 15.091 with 6 degrees of freedom, significant at .0196.

SOURCE: GG+A's LA/OMA Household Survey, January 1978

THE USE OF PLANTING MATERIALS BY LA/OMA HOUSEHOLDS

THE PURCHASE OF PLANTING MATERIALS

Each respondent who indicated that someone in his or her household had the responsibility for the care of either indoor or outdoor plantings was then asked if, in 1977, one of the following purchases had been made by a member of the household: indoor plant food, potting mix, soil conditioner/amender, fertilizer products and/or top soil.

Table 3.5 presents the number and percent of the LA/OMA sample households by county who purchased one or more planting material products in 1977. *The percentage calculations are based on all households, including, those households who do not care for plantings as well as those who do but who did not purchase any planting materials in 1977.* Orange County respondent households were more likely to buy all types of planting material products than were those respondents living in Los Angeles County.

TABLE 3.5
THE NUMBER AND PERCENT OF THE LA/OMA SURVEY HOUSEHOLDS WHO PURCHASED ONE OR MORE PLANTING MATERIAL PRODUCTS IN 1977

	Number and Percent of LA/OMA Sample Households Who Purchased:									
	Indoor Plant Food		Potting Mix		Soil Conditioner/ Amender		Fertilizer		Top Soil	
	#	%	#	%	#	%	#	%	#	%
L.A. County Respondent Households	180	40	193	43	67	15	173	39	16	4
Orange County Respondent Households	63	54	71	61	29	25	52	44	5	4
Total Sample	243	43	264	47	96	17	225	40	21	4

SOURCE: GG+A's LA/OMA Household Survey, January 1978

THE ESTIMATED VOLUME OF PLANTING MATERIAL PURCHASES

The amount of planting material (potting mix, soil conditioner/amender, fertilizer and top soil) products purchased by the average household in 1977 is shown in Table 3.6. The volume of indoor plant food purchases was not ascertained because these products were not perceived as potentially close substitutes to a sewage sludge-based product. In response to the total 1977 amount estimates, some respondents provided answers in pounds and other in cubic feet measures. Although there is no direct conversion factor between pounds and cubic feet, in the interest of comparability, cubic feet responses were converted to a poundage equivalency. After discussion with experts in the field, including nurserymen, a 40-pound per cubic foot general equivalency for all of these types of products was selected for this purpose.

Table 3.6 shows that not only is the average Orange County respondent more likely to purchase a planting material product, but he is also more likely to purchase a higher volume of these products than is the Los Angeles County respondent. The 1977 estimated volume of the four combined planting materials categories was 122 pounds per household for the Orange County sample and 92 pounds per sample Los Angeles County household. These mean volume estimates incorporate the responses of the total sample, not just those who stated they purchased a planting material product in 1977.

The mean volume estimate can be used to estimate the amount of planting material products that were purchased in the LA/OMA region in 1977 by utilizing the SCAG 1975 baseline forecast for Los Angeles and Orange Counties presented in Figure 3.1 and multiplying the number of forecast households by the survey-derived mean volumes. Table 3.7 first shows the estimated poundage and then the tonnage for each of the four planting material categories. Approximately 163,000 tons of the four combined planting material categories is estimated to have been purchased by households residing in Los Angeles and Orange Counties in 1977. Fertilizer products account for slightly more than half of this total tonnage estimate. However, this category is likely to include many products which would not be legally defined by the State of California to be fertilizer or to be reported as such in the California Department of Food and Agriculture's Fertilizer Material Tonnage Reports. To many consumers, the manure and sewage sludge-based products are fertilizers, not soil conditioner/amender products.

PLACE OF PURCHASE

Respondents were asked to specify at what type of retail store or establishment did they most frequently purchase the four specific types of planting materials. The responses to these questions are presented in Table 3.8. Nurseries attract from 40% of the potting mix to 56% of the fertilizer product sales. Discount stores account for approximately one-fifth of all fertilizer

TABLE 3.6
1977 MEAN VOLUME OF PURCHASED PLANTING MATERIAL PRODUCTS

(pounds)

	Potting Mix	Soil Conditioner/ Amender	Ferti- lizer	Top Soil	Total Products
L. A. County Respondent Households	28.63	12.28	49.22	2.38	92.51
Orange County Respondent Households	25.73	22.42	55.47	18.51	127.13
Total Sample	28.00	14.40	50.57	5.76	98.73

SOURCE: GG+A's LA/OMA Household Survey, January 1978

TABLE 3.7
ESTIMATED 1977 POUNDS AND DRY TONS OF PLANTING MATERIAL PURCHASED BY LOS ANGELES AND ORANGE COUNTIES

	Potting Mix	Soil Conditioner/ Amender	Fertilizer	Top Soil	Total
L.A. County					
Pounds	77,169,216	33,099,475	132,667,090	6,415,044	249,350,825
Tons	38,585	16,550	66,333	3,207	124,675
Orange County					
Pounds	16,030,587	13,968,355	34,559,524	11,532,303	76,090,769
Tons	8,015	6,984	17,280	5,766	38,045
Total					
Pounds	93,199,803	47,067,830	167,226,614	17,947,347	325,441,594
Tons	46,600	23,534	83,613	8,973	162,720

SOURCE: GG+A's LA/OMA Household Survey and Southern California Association of Governments, Regional Population, Housing, Employment and Land Use Forecasts: Baseline and Range, Volume I, 1978

TABLE 3.8
TYPE OF RETAILER FROM WHOM PLANTING MATERIAL PRODUCT WAS MOST FREQUENTLY PURCHASED

Type of Retailer	Potting Mix % of Households	Soil Conditioner/Amender % of Households	Fertilizer % of Households	Top Soil % of Households
Grocery	11	4	5	--
Discount	28	25	19	22
Hardware/Variety	16	17	12	11
Nursery	40	50	56	50
Lumber	2	--	3	11
Other*	3	4	5	6
TOTAL	100	100	100	

SOURCE: GG+A's LA/OMA Household Survey, January 1978

*Three of these respondents did not purchase their planting material products, but either made it themselves or received it free of charge.

to over one-fourth of all potting mix purchases. Grocery stores were identified as receiving 11% of all potting mix and lumber yards 11% of all 1977 top soil purchases. Included in the "other" category are three respondent households who did not purchase their planting material, but either made it themselves or received it free-of-charge.

KELLOGG'S PENETRATION OF THE PRESENT RESPONDENT MARKET

In any marketing investigation, there is a decided advantage to having a comparable product being distributed with which consumers are likely to be familiar in order to test present consumer familiarity and acceptance. The LA/OMA market area is fortunate in having the history of the Kellogg Supply Company to rely on. Kellogg is not the only company which manufactures and distributes sewage sludge products, but it is the major southern California processor and distributor of sewage sludge products to the home and garden as well as the specialty markets. One or more Kellogg brand products had been purchased by 23% or 83 of the 362 LA/OMA survey respondents who claimed responsibility for the care of either indoor or outdoor plantings.

The LA/OMA household survey provided a vehicle not only to ascertain the proportion of the surveyed households who had purchased one or more Kellogg products, but also to obtain insights as to their brand familiarity, product satisfaction and knowledge concerning the raw material from which the products are made. A higher proportion of Orange County (31%) than Los Angeles County (21%) respondents said a member of their household had purchased at least one Kellogg product. The χ^2 is highly significant at the .0074 level.

Perhaps of greater interest is the finding that only 27% of the total sample, 32% of the Orange County and 25% of the Los Angeles County respondents were aware that Kellogg's products are made from composted sewage sludge. *This means that almost three-fourths of those consumers who purchased these products were uninformed as to the nature of their organic content.*

Once they were made aware by the interview process that composted sewage was the basic raw material, *88% indicated that they were pleased to be using a waste product which had been recycled to provide benefit to their plantings. Only 12% said they would rather use a chemical-based product.*

TABLE 3.9
RESPONDENT SATISFACTION WITH KELLOGG BRAND PRODUCTS

	Degree of Satisfaction							
	Very Satisfied		Satisfied		Unsatisfied		Very Unsatisfied	
	#	%	#	%	#	%	#	%
Los Angeles County Respondent	13	25	36	68	2	4	2	4
Orange County Respondent	16	64	9	36	--	--	--	--
TOTAL	29	37	45	58	2	3	2	3

χ^2 = 12.006 with 3 degrees of freedom, significant at .0074 level.

SOURCE: GG+A's LA/OMA Household Survey, January 1978

THE DEMAND FOR A SLUDGE-BASED PLANTING MATERIAL PRODUCT IN THE LA/OMA HOME AND GARDEN MARKET

PRESENT EXPECTATION OF THE FUTURE USE OF A SLUDGE PRODUCT

In order to estimate the quantity of a sewage sludge planting material product which could be marketed, willingness to take or purchase a planting material made from heat-dried or composted sludge was first ascertained. The total volume those respondents who stated they were likely or very likely to use a sludge-based product would accept or purchase on an annual basis was then requested. Responses to the latter question were then averaged over the entire sample in each county in order to generate estimates of the potential per household use of a sludge product. These estimates were made under three pricing assumptions: that the product would be provided free of charge; and that it would be priced at $1 or $2/40-lb. bag. Responses given in cubic feet were again converted to pounds at the 40 pounds/cubic foot ratio in order to arrive at a unitary volume estimate. These estimates are shown in Table 3.10.

The estimates present one anomaly in that Orange County respondents indicated they would use less of the product if it were provided free-of-charge than if it were priced at $1.00 per bag. Some Orange County respondents indicated that they feel public agencies should not be manufacturing and distributing products to be distributed free of charge when such products are directly competitive with products manufactured by private enterprises. This attitude seems to explain the apparent anomaly in the Orange County demand estimates. No such anomaly or indications of a similar attitude towards public agencies was evidenced by Los Angeles County respondents.

Approximately one-fifth of all those respondents who indicated a willingness to purchase a sewage sludge planting material product said they would prefer a smaller sized package than the 40-pound bag assumption postulated in the survey. Many of these respondents were women who said they could not manage so heavy a bag. Similar surveys of consumers and nurserymen in the San Francisco Bay Region and the Portland metropolitan area confirm this finding that women do prefer less heavy bags and, further, that frequently as high as 50% of all such purchases are made by women. Nonetheless, most producers continue to produce primarily one- to two-cubic-foot or over-40-pound packages of dried fertilizer and/or soil conditioner products.

TABLE 3.10
AVERAGE ANNUAL USE UNDER THREE PRICE ASSUMPTIONS

	Free of Charge	At $1.00 per 40-Pound Bag	At $2.00 per 40-Pound Bag
Los Angeles County Respondent	67.459 lbs.	54.959 lbs.	29.684 lbs.
Orange County Respondent	66.149 lbs.	71.591 lbs.	44.191 lbs.

SOURCE: GG+A's LA/OMA Household Survey, January 1978

TABLE 3.11
PROCEDURE FOR ESTIMATING MAXIMUM QUANTITY OF MATERIAL THAT COULD BE TAKEN BY LOS ANGELES AND ORANGE COUNTY HOUSEHOLDS IN 1990

	If Priced at $1 per 40-Lb. Bag	
	Los Angeles County	Orange County
Households in County in 1990	3,047,200	896,200
X Average Annual Use per Household	54.959	71.591
= Pounds per Year	167,470,000	64,159,854
÷ 2000 = Tons per year	83,736	32,080

SOURCE: Gruen Gruen + Associates' LA/OMA Household Survey, January 1978 and Southern California Association of Governments, Regional Population, Housing, Employment and Land Use Forecasts: Baseline and Range, Volume I (Table III-2)

ESTIMATING THE POTENTIAL QUANTITY OF A SEWAGE SLUDGE PLANTING MATERIAL PRODUCT WHICH COULD BE DEMANDED BY THE LA/OMA MARKET AREA HOUSEHOLDS

Utilizing the information presented in Table 3.10 in combination with the household forecasts supplied by SCAG which were presented in Table 3.1, estimates of the maximum quantity of a sewage sludge product which could be used by the LA/OMA market area households can be formulated. *The likelihood that the actual quantity of material to be used by LA/OMA households will come close to the maximum estimate will depend partially upon the degree to which the product can be made to meet consumer expectations and the aggression with which the product is promoted and marketed.* At a minimum, it must be odorless, safe, packaged in attractive and conveniently sized bags, and made readily available at conveniently located retail outlets. Table 3.11 shows the procedure for estimating the maximum quantity of a sewage sludge planting material product which could be marketed to LA/OMA households in 1990 under the $1.00 pricing assumption.

Table 3.12 shows the result of going through the mathematical steps described in Table 3.11 to estimate the maximum number of tons which are likely to be demanded by LA/OMA households in 1980, 1985 and 1990 under the three pricing assumptions. This information is also backcast for the 1975 period. These forecasts of demand represent estimates of intrinsic demand. They indicate the maximum potential sludge product sales given an aggressive, effective marketing program and assuming that consumers actually purchase as much as they indicate they would. The latter supposition is, however, generally not accurate; experience has shown that even the best marketing program will not capture all of the potential sales within a given market. The survey shows that between 30-50% of those indicating they would use a sludge product said they would be "likely" to use it rather than "very likely" to do so. A reasonable estimate of the realizable proportion of estimated intrinsic demand based on experience would be between 70-80%. For example, intrinsic demand in 1980 at $2.00 per bag is estimated at 57,659 tons (see Table 3.12) while between 40,298 - 46,055 tons is likely to be the maximum realizable sales at that price.

Table 3.12 gives estimated annual sales at three different prices ranging from $2.00 - $0 (free of charge) per 40-pound bag. These price and volume relationships for total demand in 1980 are graphed in Figure 3.2. The figure portrays the elasticity of demand or the relationship between the quantity demanded and the price at which the product is offered. The figure shows that the quantity demanded rises at a moderate rate as the price drops from $2.00 - $1.00 per bag. The elasticity, which is the percentage change in volume demanded divided by the percentage change in the price, is a bit less than one in this price range; therefore, demand is said to be

TABLE 3.12

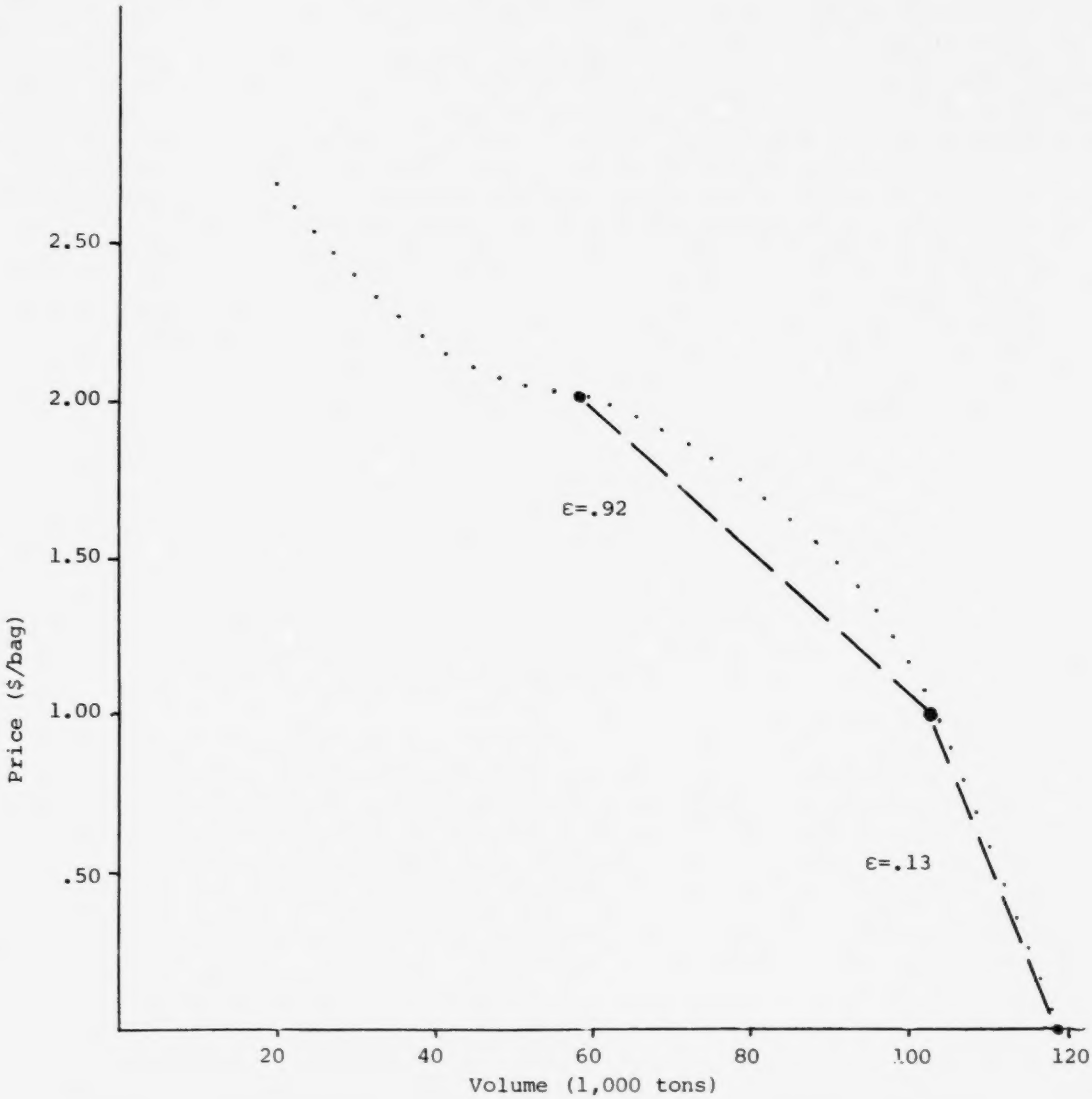
THE LA/OMA ANNUAL TONNAGE DEMAND FOR A SEWAGE SLUDGE PRODUCT GIVEN AWAY FREE OF CHARGE AND PRICED AT $1.00 OR $2.00 PER 40-POUND BAG (1975-1990)

	1975			1980		
	Free of Charge	At $1.00 per 40-Lb. Bag	At $2.00 per 40-Lb. Bag	Free of Charge	At $1.00 per 40-Lb. Bag	At $2.00 per 40-Lb. Bag
Los Angeles County:	90,914	74,068	40,005	94,493	76,984	41,580
Orange County:	20,606	22,302	13,766	24,068	26,048	16,079
Total	111,520	96,370	53,771	118,561	103,032	57,659

	1985			1990		
	Free of Charge	At $1.00 per 40-Lb. Bag	At $2.00 per 40-Lb. Bag	Free of Charge	At $1.00 per 40-Lb. Bag	At $2.00 per 40-Lb. Bag
Los Angeles County:	98,652	80,372	43,410	102,781	83,736	45,227
Orange County:	26,860	29,070	17,944	29,641	32,079	19,802
Total	125,512	109,442	61,354	132,422	115,815	65,029

SOURCE: Gruen Gruen + Associates' LA/OMA Household Survey, January 1978 and Southern California Association of Governments, Regional Population, Housing, Employment and Land Use Forecasts: Baseline and Range, Volume I, (Table III-2)

FIGURE 3.2
ESTIMATED DEMAND FOR A SLUDGE PRODUCT IN 1980 AT THREE WIDELY VARYING PRICES



SOURCE: Gruen Gruen + Associates' LA/OMA Household Survey, January 1978.

slightly inelastic in this range. When the price drops further, from $1.00 - $0 per bag, the quantity demanded rises more slowly, since the elasticity is much less than one, or very inelastic, over this rather wide range. (In order to compute the elasticity between zero and $1.00, the demand at zero was assumed to approximate that at one cent.)

The point on the curve at which the elasticity equals one is significant as decreasing the price below that point will produce diminishing total sales revenues since the percentage change in quantity demanded will rise less rapidly than the change in price. In order to estimate the point at which elasticity is likely to equal one, it will be helpful to visualize the demand estimates developed here as merely three points on a curve likely to look like the dotted line on Figure 3.2. While the elasticity of demand between the $2.00 and $1.00 per bag prices is estimated at .92, the elasticity over smaller price ranges is likely to vary. Research indicates that the elasticity is probably less than one at a price of about $1.50 - $1.60, but probably greater than one at $2.00. Therefore, one would certainly not want to drop the price below $1.60, as doing so would produce lower total sales revenue.

THE LIKELY EFFECTS OF ACTIONS PROPOSED BY THE DEPARTMENT OF HEALTH ON HOUSEHOLD DEMAND FOR A SLUDGE PRODUCT

The primary public health issue associated with the use of sludge products concerns their content of heavy metals. Many heavy metals are beneficial in very small quantities but become harmful and even quite toxic in greater volumes. Sludges contain varying quantities of heavy metals depending on the volumes entering the wastewater from which the sludge is derived.

A PRODUCT WARNING LABEL

The State of California Public Health Department is considering whether a warning label should be mandatory on all sludge-based planting material products to be sold or distributed within the state. The impact that a sample label would have on future acceptance or sales of a sludge product was tested in the household survey. Each respondent who had indicated that a member of their household took care of either indoor or outdoor plantings was asked the following question:

TABLE 3.13
ESTIMATED DECREASE IN TONNAGE DEMANDED ANNUALLY IN 1990 AS A RESULT OF A SAMPLE PUBLIC HEALTH WARNING LABEL

	Free of Charge	At $1.00 per 40-lb. Bag	At $2.00 per 40-lb. Bag
Los Angeles County:			
Demand Estimate Without Warning Label	102,781	83,736	45,227
Estimated Decrease due to Warning Label	19,528	15,910	8,593
New Demand Estimate Assuming Warning Label	83,253	67,826	36,634
Orange County:			
Demand Estimate Without Warning Label	29,641	32,079	19,802
Estimated Decrease due to Warning Label	2,371	2,566	1,584
New Demand Estimate Assuming Warning Label	27,270	29,513	18,218
Total:			
Demand Estimate Without Warning Label	132,422	115,815	65,029
Estimated Decrease due to Warning Label	21,899	18,476	10,177
New Demand Estimates Assuming Warning Label	110,523	97,339	54,852

SOURCE: GG+A's LA/OMA Household Survey, January 1978 and Southern California Association of Governments, Regional Population, Housing, Employment and Land Use Forecasts: Baseline and Range, Volume I, (Table III-2)

11. How likely would you be to use a sludge-based product if it had this warning on the package?

"This material should not be added to soil that is intended to be used or usable for production of vegetables or fruits to be eaten by humans unless those vegetables or fruits are cited in a list published by the California Department of Health which indicates that use of sludge on soil producing those items is acceptable."

very likely __, likely __, unlikely __, or very unlikely__.

Nineteen percent of the Los Angeles and eight percent of the Orange County respondent sample claimed they would be unlikely to use a sewage sludge planting material product if it bore a label with the wording shown in question 11. These estimates are based on the decline in willingness to use the product indicated by the responses to question 11 in comparison to those to question 10. The resulting estimated decrease in demand assuming those declining to use the product due to the sample warning label would have used the average volume demanded are shown in Table 3.13 for the 1990 estimates of demand. Study findings indicate that a requirement for a visible warning label would reduce the household market for a sludge product in this market by about 16% or from 22,000 tons if the product is offered free to 10,000 tons if it is sold at $2.00 per bag. Further, it is likely to adversely affect the demand for sewage sludge products currently being marketed in the LA/OMA region since the survey indicates that a high proportion of today's consumers are unaware that the Kellogg brand products are made from composted sewage sludge.

ADDING LIME TO A SLUDGE PRODUCT

As organic matter decomposes, it produces acid. The pH factor is a measure of the concentration of acids present in a material; if the pH is low, there is a strong concentration of acid, while higher values indicate weak concentrations. Thus, organic matter such as sludge may be introduced to the soil as a material with a relatively high pH, but the acid produced during the decomposition will tend to lower the pH of the organic matter and that of the soil with which it is mixed. Lime has a very high pH value. It is commonly used to control the pH of soils which would naturally have low pH factors.

The lower the pH of the soil the more rapidly it releases heavy metals to plants. The State Department of Health is therefore considering requiring producers of sludge products which contain heavy metals to add lime to their products. The purpose of adding the lime would be to maintain the sludge at some minimum pH value so that the acid produced during decomposition would not promote rapid release of heavy metals to plants. The result of adding lime to sludge would be that the sludge would have an initially high pH value which would be neutralized as the organic matter in the sludge decomposes.

LA/OMA Project study area soils tend to have relatively high pH factors naturally. Acid-loving plants, particularly young ones, require special plant foods to counteract the effects of the high pH factors of local soils. The effect of material such as sludge with lime added with even a neutral pH factor (in the long run) would not be detrimental in this environment. The effect of the initially high pH of a sludge product with lime added, however, could require additional special treatment for acid-loving plants. The potential effect of this requirement was not tested in the household survey as the proposal was received after its completion; however, the effect of the addition of only enough lime to counteract the acidifying effect of decomposition does not seem likely to cause a sludge product to be unmarketable, though it could have some impact on estimated sales.

MARKETING STRATEGIES AND ESTIMATES OF RESULTING POTENTIAL SALES REVENUE

The important characteristics of the home and garden market described in this chapter, in combination with the demand estimates at various price levels developed here, have important implications for the type of marketing system and pricing strategy required to successfully maximize long-term sales in this market.

First of all, product quality and liability concerns strongly suggest that the public sewage treatment agency is the best organization to produce the composted or heat-dried sludge product. Likewise, a contract between the producing agency and a single firm in the region willing to process, store, bag and distribute the final product(s) to the home and garden market has been shown to be the most effective system in the long run for serving the home and garden market. Marketing programs and their relationships to all three potential markets are further discussed in Chapter 6.

Assuming a public agency produced and a private firm marketed a sludge product to the home and garden market in the LA/OMA study area, the resulting potential sales revenue to be received by the public agency producer may be estimated by calculating the marketing costs and subtracting these costs from the retail sales values of sludge products estimated previously in this chapter. Estimates of ranges of sales revenue which could be received by the producer at three retail sales values are shown in Table 3.14 and discussed below.

The first line in Table 3.14 shows the retail sales values at which demand was tested by the household survey. The $2.00 per 40-pound bag price is the most directly comparable to the price of Nitrohumus, the sludge product currently being sold in the LA/OMA study area by the Kellogg Supply Company. The two lower prices were tested in order to provide estimates of the volume of a sludge product which could be consumed if the price were maintained at a level lower than comparable and competitive products. Retailers' mark-ups, shown on the second line, are estimated at 40% of the retail sales value of the product. This estimate is based on Gruen Gruen + Associates interviews with retailers of planting materials in the Los Angeles, San Francisco and Portland regions. There is no mark-up shown where the price is free as it is assumed that distribution would be through recycling centers at very little or no cost. Estimated ranges of the costs incurred by the private marketing firm for activities such as processing, bagging, warehousing, delivery and sales and promotion are shown on the third line. These estimates are based on estimates of the costs experienced by the Kellogg Supply Company, corraborated by producers of comparable products. These

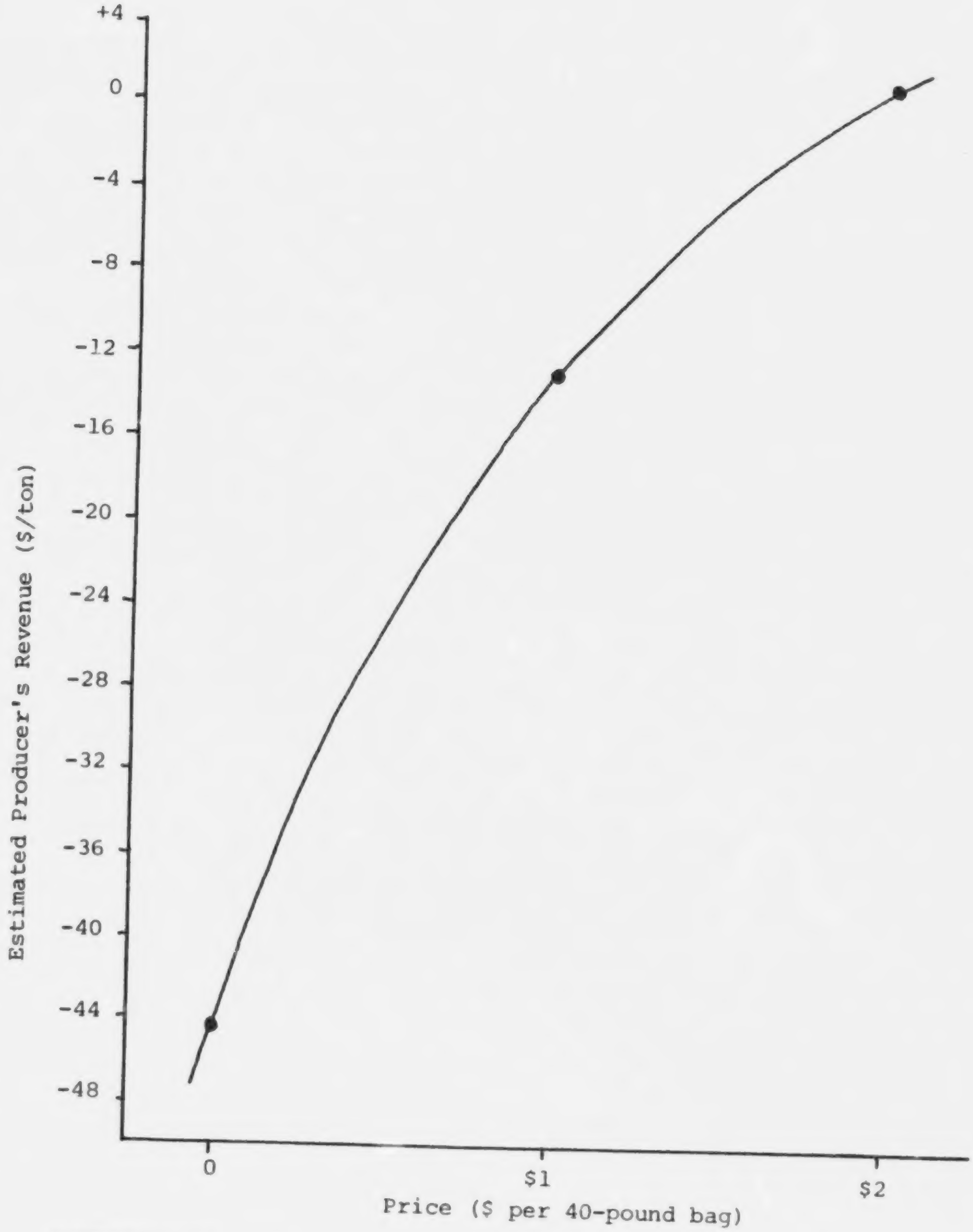
TABLE 3.14
ESTIMATED PRODUCER'S REVENUE FROM SALES OF A SLUDGE PRODUCT

Retail Sales Value	Free of Charge	$1.00 per 40-lb. Bag	$2.00 per 40-lb. Bag
Estimated retailer product mark-up (40% of sales price)	[1]	.40	.80
Estimated marketer's processing, bagging, warehousing, sales, delivery costs and profit or service charges	.79-.81[2]	.86-.88[2]	1.16-1.20[2]
Resulting potential sales revenue to producer			
per 40-lb. bag	(.79)-(.81)	(.25)-(.27)	0.00-.04
per ton	(39.50)-(49.50)	(12.50)-(13.50)	0.00-2.00

SOURCE: Gruen Gruen + Associates' Interviews with Existing Retailers and Distributors of Sludge Products.

1. No mark-up is shown as it is assumed no retailer would be directly involved in distribution of a free product.
2. Costs are lower at the lower price because volume increases and costs and profit or service charges are assumed to vary with volume.

FIGURE 3.3
ESTIMATED PRODUCER'S REVENUE FROM SALE OF A SLUDGE PRODUCT AT DIFFERENT PRICE LEVELS



SOURCE: Gruen Gruen + Associates

cost estimates also include estimates of the profit or service charges necessary to reward the marketing firm for its efforts. Profit or service charges were estimated based on information supplied by the Kellogg Supply Company, judgmentally adjusted by Gruen Gruen + Associates, based on experience in other studies. It is important to note that these cost estimates do not include transport of the sludge product from the producing agency to the marketing firm. The final lines show the ranges of values of the sludge product to the producing agency depending on the retail sales price per 40-pound bag and converted to a tonnage basis. Because of the sparseness of data, the range of possible error associated with these estimates is large, though Gruen Gruen + Associates feels confident of the direction and general magnitude of the estimates.

The resulting estimates of the value of a sludge product to the producing agency are graphed in Figure 3.3 using the mid-points of the ranges for each sales price shown in Table 3.14. The curve connecting the three points at which estimates were made is provided as an example of the probable shape of the actual curve. Using the curve or interpolating between the estimates indicates that the retail sales price of about $1.90/40-lb. bag is the point at which the marketing firm can break even in the long run on costs and estimated profits, paying nothing to the producing agencies. These estimates reflect the costs, profit and potential returns associated with an established marketing program.

There are two reasons that it would be in the interest of the producing agency or agencies to at least initially accept a lower return and simultaneously encourage the marketing firm to price the product at or perhaps even above the $2 per bag price. The first is that attaining the 70-80% of intrinsic demand it is estimated could be captured by a sludge product will require a substantial marketing effort over a period of years whether the product is marketed as a new product or under the label of an existing brand name such as Kellogg's Nitrohumus. The second reason is that many of the factors which are important to users in this market, such as the brand name, packaging, product recommendations, and product identification based on advertising, suggest that it may be possible in the long run to actually shift the demand curve for the LA/OMA sludge product through substantial long-term investment in advertising and promotional efforts aimed at differentiating the LA/OMA sludge-based soil amendment from other soil amendments, including other sludge-based soil amendments.

It may therefore be desirable for the producing agencies to simultaneously: 1. encourage the marketing firm to price the product at or even above the $2.00 price; 2. encourage the marketing firm to accept and attempt to market no more than 70-80% of estimated intrinsic demand at that price; 3. accept no return from or even subsidize the marketing firm; and 4. encourage the marketing firm to reinvest as much revenue as possible in appropriate advertising and promotional efforts. The desirability of pursuing such a strategy depends on the comparative benefits and costs of this strategy and other sludge disposal alternatives.

CHAPTER 4

THE SPECIALTY MARKETS

INTRODUCTION

DEFINITIONS

The specialty market for sludge-based fertilizers and soil amendments is easier to define in terms of what it is not than what it is. The specialty market is made up of business firms, individuals and other organizations who would be willing to buy sludge-based material, usually in bulk, for applications other than commercial agriculture and home gardening. The users, or potential demanders, of sludge-based materials in this market are a relatively diverse group. Their uses of sludge-based material can be grouped into three categories. Table 4.1 below lists the likely significant users of sludge-based material in this market and the uses to which they would apply a sludge-based fertilizer or soil amendment.

TABLE 4.1
THE SPECIALTY MARKET: USES AND USERS

Uses:	Landscape Construction	Landscape Maintenance	Plant Propagation
Users:	Landscape Contractors and Architects	Golf Courses, Cemetaries and Memorial Parks; Park and Public Works Departments; Schools & Colleges; CalTrans	Wholesale Nurseries; Turf Farms; U.S. Forest Service

SOURCE: Gruen Gruen + Associates

APPROACH AND ORGANIZATION OF THIS CHAPTER

No reasonably comprehensive and accurate records of historic or present sales of soil amendments and low nutrient-content fertilizers were uncovered in the course of the study. Therefore, the quest for information on the nature of demand in the specialty markets concentrated on interviews and mailed questionnaires with a sample of users of such materials in these markets, and drew from information on specialty user demand developed in studies of of the markets for sludge in San Francisco and Portland.

The interviews and questionnaires probed first for information about the demand parameters that apply to each user category. The interviews sought to identify the factors which influenced the quantity of the sludge-based soil additive which would be taken by the various users at alternative prices, and to understand the weights or importance of these factors as they influenced uses of fertilizers and soil amendments for the purposes they are likely to be applied by the identified potential users. Thus, the estimates of the demand for sludge-based fertilizers and soil amendments were not drawn from the responses to a single question that merely asked the users how much of such products they were prepared to buy at alternative prices. Instead, the interviews concentrated first on finding out the types of organic and inorganic soil amendments and fertilizers which current users were presently buying and applying. Users were next questioned concerning the reasons behind the choice of products they were presently using. These reasons, or preference factors, permitted identification of relevant demand parameters which applied to each type of user; that is, it became possible to identify the product-related and other types of variables which significantly influenced the willingness of users to buy soil amendments and fertilizers. With this information, which turned out to be remarkably similar among the differing users, it was possible to develop a list of criteria which must be met by any sludge-based product likely to find any significant acceptability in the specialty market.

The estimates of the likely quantity of sludge-based material which would be demanded by the specialty market at differing prices, was also drawn from the interviews and questionnaires. Several questions were asked in order to estimate the volume of organic material and fertilizers and soil amendments currently being purchased by each of the contacted firms or public agencies. They were then questioned concerning their willingness to switch over a part of their demands from the products they were currently using to sludge-based materials that met listed criteria at various price levels. Finally, they were directly asked the amount of sludge-based material they might use, should such a material be available at alternative prices. From their answers, the amount of a sludge-based material that they would be willing to take at two price levels was estimated. They were also asked the approximate volume of sludge-based material they were currently purchasing. At the present time, the Kellogg Company is marketing sludge-based soil amendments and low grade fertilizers. It is estimated that Kellogg's sales of composted sludge to specialty markets was approximately 22,000 tons last year.

In order to reach estimates of total amounts of sludge-based materials which could be taken by various categories of users in the specialty markets, it was assumed first that the firms and organizations contacted were typical of all such firms in Los Angeles and Orange Counties; with that assumption, the average amount of material which it was surmised those interviewed would use was multiplied by the estimated total number of users in each category. Such estimates were made both for all sludge-based products and for the amount of material provided by the Kellogg Company which they had actually utilized last year. This process led to an estimate of Kellogg products that was in excess of the 22,000 tons assumed to have actually been sold by Kellogg; therefore, the estimate of total demand for a sludge product was adjusted downward by the proportion that the procedure had led to an overestimation of Kellogg's sales for last year. While it is difficult to apply any statistical test to this procedure, Gruen Gruen + Associates would argue that it provides a thoroughly reliable judgmental estimate of the quantity of a sludge-based material capable of meeting the identified product criteria which could be sold, and gives even more confidence in the validity of those criteria.

The next major section of this chapter contains analyses of the components of the specialty market including landscape architects and contractors, golf courses, cemeteries, parks and public works departments, school districts, Caltrans, wholesale nurseries, turf farms and the U. S. Forest Service. The analysis of each of these components of the specialty market describes the products currently purchased by the users, the characteristics of greatest importance to the users and the estimated demand of these users for a sludge product based on assumed product characteristics and different prices.

The final major section of the chapter describes the conclusions concerning the demand for a sludge compost product in the specialty markets. These conclusions include a listing of the features which any such product would have to have in order to be marketable and estimates of the quantity of the product which could be marketed at two price levels. The conclusions describe the key relationships between the quantity of a sludge compost which could be marketed and the price of that product, as well as the interrelationship between the amount of sludge compost which can be marketed at a given price and the price of substitute soil amendments, primarily wood by-products. The conclusions also discuss the potential impacts of requirements which might be promulgated due to health concerns regarding sludge use. Finally, the conclusions discuss the sales revenue a sludge producing agency could expect to receive from a marketing program.

The questionnaire form utilized in the mailings and as the basis for the phone interviews is included as Appendix D.

LANDSCAPE CONTRACTORS AND ARCHITECTS

THE ROLES OF ARCHITECTS AND CONTRACTORS

The landscape contractor actually purchases the fertilizers and soil amendments used in each job; however, the landscape architect is the key to the purchasing decision in new construction where most soil amendments are used. The architect specifies the types and volumes of materials to be used in installations. While the architect may allow the contractor some opportunity to substitute various products on private contracts, government contracts are usually quite specific. Consequently, *the importance of the role of landscape architects to the future of sludge use cannot be overstated.*

Most landscape contractors contacted during the current study provide a maintenance service as well as engage in new construction. The variety of materials and practices employed by landscapers is considerable, but limited by the same basic factors which determine the choices of other commercial fertilizer and soil amendment users: price and economy of labor.

To these ends, chemical fertilizers have been universally adopted by contractors for use in landscape maintenance. Organic products are considered to be too expensive, too bulky, and too slow in producing the dramatic results which their clients expect. Some organic-based fertilizers are used, but generally only when specified by a customer.

In maintenance and new construction, however, several organic soil amendment products are used by landscapers.

CHARACTERISTICS DESIRED IN SOIL AMENDMENTS

The characteristics which landscape architects and contractors demand of a soil amendment are:

1. Price - the most frequently mentioned quality. Landscapers' estimates of value range from $4 to $12 per cu. yd., delivered. The average was $6.70, approximately that which is paid for top quality nitrolized sawdust.
2. Sterile - no seeds or pathogens.
3. Texture - the material must be of uniform particle size and not dusty; landscapers must be able to apply it with both drop and broadcast spreaders. The material must have a similar mulching quality to that of sawdust or other organics.

4. Salt content must be low - landscape architects suggested that the electrical conductivity of the saturation extract should not exceed 3.5 millimhos per centimeter at 25° C.

5. Heavy metal content should be within tolerable limits. Limits will vary by the type of planting.

6. Minimal odor is required - a factor which severely limits landscape applications of steer manure.

7. Ready availability and delivery are necessary.

Although all specialty users of fertilizer and soil amendments interviewed during this study were concerned with price, no group was as sensitive to this feature as landscape architects and contractors. *Price was referred to repeatedly and consistently as the most important factor* in selecting landscaping materials. Since the opinions of landscape architects are the key to which materials are used in much new construction, the impressions of many of those interviewed are summarized below to illustrate the degree of price sensitivity: put the product on the market at a competitive price and it will sell. (Sludge) has been proven to be a good product; price determines what is used in this business. Make it competitive with redwood shavings, etc. and it will sell; make it cheaper than these and you will corner the market.

Indicative of the differences of opinion possible in this field, estimates concerning the substitutability of sludge for conventional organics ranged from zero to 100%. In the absence of the product to personally examine, or of reliable evidence to its actual performance, no one could be certain for what material and in what proportions the proposed sludge product could be substituted. Familiarity with other sludge products currently on the market provided some guidance: most of those landscapers interviewed who could provide an estimate suggested that the sludge product could be substituted for as much as 50% of the organic material currently in use if it conformed to their list of criteria. Customary soil amendment products are summarized below.

WOOD BY-PRODUCTS

Wood by-products comprise 87% of the soil amendments consumed by landscape contractors in the LA/OMA study area. Several varieties and sources of material are available, but the Long Beach Redwood Company seems to dominate the soil amendment field at least in terms of the construction industry. Sawdust and shavings from both fir and redwood are available as well as products which have been composted and/or fortified with nitrogen (generally ammonia) to reduce the nitrogen consumption characteristic of decaying organic matter. Generally, only very small quantities of nitrogen are added (.25% N) to partially compensate for that which is consumed by the material itself as it decomposes in the soil. These fortified products are referred to variously as "nitrolized", "nitro-stabilized" or "ammoniated" sawdust and shavings. The cost of the products most commonly used in landscaping averages $5 to $6 per cubic yard, delivered.

STEER MANURE

Steer manure is avoided by landscape contractors for these reasons: odor, weed potential and high salt content which results in "burning". At $3 to $6 per cubic yard, steer manure is less expensive than comparable products; consequently, it is used for some new construction where materials are specified by an architect rather than the contractor, and where price is even more important than usual.

MILORGANITE

Milorganite, the product of the City of Milwaukee's sewage treatment facility, is primarily used by a limited number of maintenance services. In the past, Milorganite enjoyed wider acceptance as a fertilizer but rising freight costs have made its use prohibitive except in those instances when it is especially requested by a customer. Milorganite, with an unusually high nutrient content for sludge (6-1-0), costs $6-$7 per 50-pound bag (approximately 2½ cubic feet) and it is usually applied as a top dressing to lawns. Those who choose Milorganite generally value the slow-release quality of organic products as well as its mulching characteristics.

NITROHUMUS

Nitrohumus is the composted sludge material produced by Los Angeles County and distributed by the Kellogg Company. The relatively low nitrogen content (approximately 2%) prevents the material from being marketed as a fertilizer. Several other products are available from Kellogg which are blends of Nitrohumus and other organic material (e.g., Topper, Amend). Due primarily to the product's relative lack of odor and lower sodium content, Nitrohumus has supplanted steer manure as the material of choice both for new lawn installations (as mulch and top dressing) and ornamental landscaping (pit plantings, flower beds, etc.); wherever cost and soil conditions allow, it is used instead of steer manure and wood by-products. Nitrohumus is especially useful in amending the sandy loam characteristic of much of the San Fernando Valley and Orange County; however, it has beneficial effects on all soils.

ESTIMATED DEMAND FOR SLUDGE PRODUCTS

The maintenance services and landscape contractors sampled during the current study (approximately 4.5% of the total population) each consume an average of 592 cubic yards of organic material annually. There are currently approximately 520 landscapers/gardeners in the Los Angeles/Orange County area. If each consumes organics at the rate of the sample, nearly 307,630 cubic yards are used by this industry each year; approximately 7% (22,513 cubic yards) of this total is comprised of Kellogg's Nitrohumus or the Nitrohumus component of blended products (e.g., Amend which consists of approximately 25% sludge and 75% composted rice hulls).

Estimated volumes of organic soil amendments used by landscape contractors in the LA/OMA study area are summarized below. The sample from which these projections were made represents approximately 4.5% of all contractors in the study area.

Wood by-products	266,621 cu. yds.	87%
Nitrohumus	22,513 cu. yds.	7%
Poultry manure	12,388 cu. yds.	4%
Steer manure	1,177 cu. yds.	.4%
Other	4,930 cu. yds.	1.6%
Total organic soil amendments consumed by landscape contractors:	397,630 cu. yds.	100%

Recent difficulty in obtaining supplies of Nitrohumus have prevented some landscapers from using as much of the material as they would have if it had been more available. Some contractors have occasionally found it necessary to negotiate with architects to substitute a more available product when Nitrohumus was specified, and some maintenance services have been able to purchase only bagged Nitrohumus at a significantly higher cost than bulk rates. From interviews with these specialty users it is estimated that the current demand for Nitrohumus is at least 16% greater than actual sales. This estimate is based on current levels of marketing effort and the existing price structure. Clearly, if more material were available, an increase in marketing effort would be warranted, and would certainly have a substantial effect on demand.

Because contractors are willing to purchase sludge products at widely varying prices (yet price is the single most important determinant of the volume which will be purchased), it was necessary to make two separate volume estimates based on different product price assumptions. At the current rate for Nitrohumus, approximately $9 per cubic yard, landscapers will restrict their use of the product to only high priority areas, and thus it is estimated they would consume about 26,000 cubic yards, while at a price of about $5.50 per cubic yard it is estimated that they would be willing to purchase between 78,000 and 80,000 cubic yards of a sludge product with the required characteristics.

GOLF COURSES

Golf course greenskeepers have an awesome responsibility: they realize that their turf is expected to set a standard which all other lawns can only hope to approximate. Golfers' expectations of a course correspond roughly to the amount it costs them to play, but greenskeepers of even the humblest par 3 or municipal course recognize that the quality of their customers' games are both subjectively and directly affected by the condition of the turf. Because it is a surprisingly competitive business, the universal objective of golf course managers is satisfied golfers. To this end, golf course maintenance forms the first line in the struggle for green, healthy grass.

FERTILIZERS USED

In addition to color, several other qualities are important to greenskeepers. The texture of putting greens is the primary concern, followed by the maintenance of tees; the third priority is the condition of fairways. In each of these areas, high nutrient-content chemical fertilizers are used by all golf courses sampled during the current study (e.g., 22-0-16, 16-8-8). Occidental Chemical and the O. M. Scott Company dominate this field and provide specialists' services in both soil analysis and trouble-shooting. Organic fertilizers are generally shunned by greenskeepers for several reasons: 1) they lack the quick-release capacity of chemical products, and consequently organics rarely deliver the prompt and dramatic results required by golf courses; 2) organic fertilizers are generally lower in nutrient content than chemical products, requiring greater volumes to achieve desired nutrient levels. This can translate into higher labor costs and/or excessive amounts of organic material on the surface of the grass; and 3) organic fertilizers are generally more expensive per unit of nutrient than chemical products.

DEMAND FACTORS

The characteristics which golf course greenskeepers require of an organic soil amendment are: 1) that it have a uniform particle size so that it is not too dusty and can be applied with existing equipment (broadcast and drop spreaders); 2) that the material be sterile (tomato seeds have been a problem with some sludge products); and 3) that the material contain few salts.

The traditional form of greens maintenance has been to aerate the turf by mechanically removing several hundred plugs of sod (3/8" x 2") and then filling the holes (by use of spreader and drag) with a top dressing mixture of an organic soil amendment, fertilizer and sand. This process relieves compaction from constant foot traffic, aids in drainage of the green and also helps to control the accretion of excessive thatch. Various combinations of materials are used; the mixture generally reflects the accumulated experience of the greenskeeper and the specific requirements of his soil, as well as factors such as the local availability of products and the materials budget of the golf course. Several use mixes of sand, redwood bark, sawdust, mushroom compost, processed chicken manure and two sludge products (Milorganite and Amend); proportions range from 50% sand, 50% organic matter to 100% sand.

In other areas where similar sludge feasibility studies have been conducted, there has been a trend toward straight sand application. This is believed to reduce the need for labor intensive aeration and contribute to a smooth green by filling voids. Due largely to the already sandy soils in much of the LA/OMA project study area, this trend does not appear to be a significant factor.

Organic soil amendments are also used in golf course maintenance when rebuilding tees and greens. After the sod has been removed, sand and a mulch-like soil amendment are rototilled into the soil to provide a medium for new turf. However, rebuilding is rare, being limited to very old courses or those poorly constructed.

Estimated volumes of organic soil amendments used by golf course greenskeepers in the LA/OMA study area (with sample size of 6.5%) are listed below:

Nitrohumus (sludge component of Amend)	675 cu. yds.	12.3%
Other (mulch component to Amend)	2041.2	37%
Wood by-products	1005	18.2%
Peatmoss	929	17%
Mushroom compost	756	14%
Chicken manure	62	1%
Milorganite	28	.5%
Total organics consumed by 108 golf courses	5497 cu. yds.	100%

POTENTIAL DEMAND

Unless the sludge material was fortified with chemical fertilizer (to more than 5% nitrogen), it would find little acceptance among golf course greenskeepers as a fertilizer. The slow-release nature of organics and the greater volume required are major obstacles. However, if the material were substantially cheaper than chemical products, that is, if its cost per unit of nutrient was low enough to justify the additional labor required for its application (in the range of $10 to $15 per cubic yard), a sludge-based fertilizer could capture a portion of the fairway fertilizer market. The volume which could be sold for such use is difficult to estimate, but is probably considerably less than that which may be used for top dressing.

Sludge-based soil amendments already enjoy wide acceptance as a component of top dressing mixtures used in greens maintenance. Over 28% of the greenskeepers contacted during the current study use either Milorganite or Kellogg's Amend; Amend is a loamy blend of Nitrohumus and composted rice hulls. Although it is difficult for potential users to place a value on an unseen product, the presence of similar products on the market provides some guidance: Amend sells for about $11 per cubic yard; pure Nitrohumus sells for $9 per cubic yard; and bark dust sells for about $5.50 per cubic yard. Those interviewed felt that if the proposed sludge product satisfied their criteria for organic material it would be worth as much as $9 per cubic yard delivered, but could compete with bark dust only at a comparable price of $5.50 per cubic yard.

Golf courses contacted during the current study each use an average of 51 cubic yards of organic material annually. Since there are about 108 golf courses in the LA/OMA study area, approximately 5,508 cubic yards of organics are consumed, primarily for purposes of top dressing; approximately 700 cubic yards (13%) are sludge material.

If a sludge product were priced at about $5.50 per cubic yard, in order to compete with bark dust it is estimated that such a product could be substituted for as much as 100% of the organic material used in top dressings or about 5,500 cubic yards.

CEMETERIES AND MEMORIAL PARKS

FERTILIZER USE

The goal of cemetery grounds superintendents is to present a well-manicured landscape. To achieve the lush green lawns required to project an image of eternal peace and dignity, most cemeteries apply a chemical similar to that used on golf course fairways (e.g., 16-6-8). Organic fertilizers are avoided for the same reason cited by other commercial fertilizer users: cost. Both the initial price and the additional labor required for application prevent the general acceptance of organic fertilizers at this time.

SOIL AMENDMENTS

In terms of organic soil amendments, limited amounts of Nitrohumus and steer manure are used by cemetery personnel, primarily for ornamental plantings and to prepare or restore sandy areas for lawns. Steer manure enjoys wide acceptance for these purposes due largely to its low cost ($3 to $6 per cubic yard) and immediate availability (delivered within 24 hours). Nitrohumus is nevertheless used in limited quantities for these purposes and is usually purchased in 50-pound bags for slightly over $1 each. The potential negative features of a sludge product which are of concern to cemetery operators are odor and the potential of the product to stain bronze markers if applied with mechanical spreaders.

Estimates of organic soil amendments consumed by 69 cemeteries in the LA/OMA study area (7.3% of the total population sampled) are:

Steer manure	2132 cu. yds.	97%
Soil builder	41	2
Nitrohumus	21	1
Total organics	2194 cu. yds.	100%

POTENTIAL DEMAND

It was the opinion of cemetery managers that the sludge product should cost no more than steer manure ($3 to $6 per cubic yard); some felt that it should be substantially less (e.g., $2 per cubic yard). Cemeteries contacted during the current study used an average of 32 cubic yards of organic soil amendment last year. Since there are approximately 69 cemeteries and memorial parks in the LA/OMA study area, a total of at least 2,194 cubic yards are consumed by this market annually. If the price of the sludge material approached that of steer manure in the $5 to $6 range, approximately 50% of this market or 1,100 cubic yards could be converted to sludge use.

PARKS AND PUBLIC WORKS DEPARTMENTS

CURRENT USE OF MATERIALS

The fertilizer and soil amendment requirements of parks and public works districts vary considerably, but a common theme in interviews with public sector landscaping personnel concerns the constraints and uncertainties of annual operations budgets. Most maintenance departments indicated needs for greater volumes of organic soil amendments than they are normally able to afford. A parks maintenance director described the situation: "We cannot afford to build . . . (turf areas) up to a good maintenance level, so we do what we can with chemicals, relying on inorganics for their quick-greening characteristics".

To save on both labor and materials costs, public agencies have universally adopted the use of complete chemical formulae (e.g., 14-3-6, 16-6-8) with Scott and Occidental products generally competing for lowest bid. Some maintenance departments blend their own inorganic fertilizer using urea, ammonium nitrate, ammonium sulphate, etc. Always the objective of these maintenance programs must be the maximum greening possible with the minimum amount of labor and material costs. Since organic fertilizers are generally more expensive and require greater volumes than chemical products to achieve nutrient goals, they have been avoided by budget conscious landscape maintenance managers.

Unlike organic fertilizers, several organic amendments are used by the public agencies contacted during this study for maintenance purposes. Significantly more material is used in new construction, but in the Los Angeles/Orange County area all but the smallest new installations are put out to bid with landscape contractors providing the materials specified in design plans. Since parks and public works departments are essentially maintenance oriented, estimates of one time installation volumes are included in those for landscape contractors.

Nitrohumus is preferred by most maintenance personnel for use in top dressings for turf and as a component of mixes used to backfill around new or replacement ornamental plantings. However, due to its relatively high cost ($9 per cubic yard, compared to $5-$6 for sawdust and $3-$6 for dairy and steer manure), Nitrohumus is generally reserved by parks and public works departments for high priority areas only. For instance, the Los Angeles County Parks Department uses both Nitrohumus and Kellogg's Amend (a blend of sludge and rice hulls) as a top dressing on high maintenance areas such as county buildings and areas near special events such as the King Tut exhibit, and Exposition Park. The material is preferred due to its humus content which promotes the growth of soil micro-organisms in otherwise inert sandy soil; the material also provides relatively low levels of slow-release nutrients. Both features can be realized by application from the top without seriously disrupting the appearance or function of the turf.

Similarly, the Pasadena Public Works Department uses redwood sawdust on compacted soils with sparse turf; the area is covered with 3 inches of sawdust, then sawdust, grass and thatch are rototilled to a depth of 6 inches. However, Nitrohumus is used on high maintenance areas, such as the Rose Bowl field and landscaping, and the lawns of the Tournament of Roses headquarters. Kellogg provides a spreader for large orders which broadcasts a 1/4-inch layer.

The City of Long Beach formerly purchased 3,000 cubic yards of redwood sawdust each year for amendment purposes. They were also paying to dispose of branches, trimmings, leaves and other organic wastes of the parks system. As a solution to this disposal problem, a grinder was purchased which allows the city to produce its own composted organic material. However, the parks department still requires about 1,000 cubic yards of Nitrohumus annually, both for use as a top dressing for high priority areas and to mix with their own product for backfill in pit plantings and flower beds.

DEMAND ESTIMATES

Estimated volumes or organic soil amendments used by parks and public works districts in the LA/OMA study area are summarized below. The sample represents 11% of the total population of these agencies. Los Angeles County Parks and Recreation Department was included in the original sample, but due to this agency's inordinate consumption of sludge, it was eliminated from the sample (e.g., 2000 cu. yds. of Amend and 500 cu. yds. of Nitrohumus vs. an average of 187 cu. yds. for all other parks and public works districts). In determining volume estimates, the total number of agencies was reduced by one, then volumes for Los Angeles County were added to the total volume estimates for all other parks and public works agencies. This adjustment is justified not only by the exceptional volumes of sludge use by the department, but also by several unsolicited comments by informants that Los Angeles County uses considerably more Nitrohumus than anyone else as a matter of policy rather than strict economic considerations.

Nitrohumus	17,179 cu. yds.	52%
Steer manure	10,282	31
Wood by-products	398	1
Milorganite	310	1
Peat	315	1
Other	4,575	14
Total organics used	33,059 cu. yds.	100%

The 11% of parks and public works districts sampled during this study reported an average annual consumption of 335 cubic yards of organic soil amendment. There are about 98 parks and public works departments in the LA/OMA study area ranging in size from five to several thousand acres. Estimates of product use based on acreage alone would be misleading since much of the larger districts' acreage is in the form of undeveloped watershed. For instance, only a few of Sierra Madre's 1,125 public acres are landscaped (traffic dividers and small urban parks), the remainder consists of natural ground cover in the foothills of the San Gabriel Mountains. For these reasons the best estimate it was possible to develop is that somewhere in the vicinity of 30,000 to 33,000 cubic yards of organic soil amendment are consumed annually by parks and public works departments in the LA/OMA study area; of this volume, approximately 52% consists of sludge or sludge-based materials, 31% is steer or dairy manure; the remainder is composed of wood by-products, peat moss and other mulching materials.

It is estimated that sludge products could be substituted for up to about 75% of organic soil amendments currently used by parks and public works departments if it were priced at about $5.50 per cubic yard in order to compete with the sawdust and manures currently being used. This would result in a market for 22,500 to 24,750 cubic yards of sludge products. The unusually high use rate of sludge by parks districts (over 50% of organics) might indicate a public sector predisposition to contribute to the solution of a civic disposal problem.

THE TREND TOWARD NATURALISM IN PARKS DESIGN

Despite the cost and labor factors which usually inhibit the use of organic fertilizers, there are two separate trends in parks construction and maintenance which may indicate an increased demand for organic products. Clearly, the ecology movement has been translated into a trend toward naturalism in parks design. That is, grassy areas are kept to a minimum and, where possible, meadow conditions are allowed to develop and all areas are mowed infrequently. In these parks, organic products are advantageous due to their low nutrient levels and slow release quality. Neither quick greening nor quick growth are objectives.

Another trend, separate from but convergent with the former, is motivated by the desire of public agency landscapers and maintenance departments to minimize labor costs. This trend is not limited to these agencies; all commercial customers of fertilizer and soil amendments are cost conscious, but this concern has reached a critical stage for parks departments. Prompted by the recent availability of the "natural" park as an alternative, some parks districts are either converting or considering conversion of certain parks to a natural design to minimize labor costs. A definite trend towards this low maintenance format is visible especially in nonurban new park construction. To this end, several parks districts are experimenting with low-analysis fertilizers such as Gro-power (5-3-1), a product of the Southern California Organic Fertilizer Company. It is believed that a sludge product with similar nutrient levels could compete with such products for this developing market. Since this trend is reflected primarily in the area of new construction, it has not been possible to develop reliable estimates of the potential impact of this trend on the future maintenance demand for sludge products. While organic fertilizers may be desirable for use on "natural" parks, organic soil amendments are not likely to be used at all, so the impacts of this trend will depend on the rate of development of such parks and the rate at which organic fertilizers are applied to them.

SCHOOL DISTRICTS

The Los Angeles City School District employs four crews in a continuous turf reconditioning program. Maintenance of the high school athletic fields occupies the months of March through September. About 30 cubic yards of steer manure are applied to each field with some overseeding in the sparse areas down the center of the fields. From September until early spring, maintenance attention is focused on the school district's 30 baseball diamonds, which receive applications of 20 cubic yards each. Additionally, another 50 grass playing fields are spread with 30 cubic yards each of top dressing. Steer manure is used because it is the least expensive material. On fields where salt is a problem, nitrolized shavings are applied. Nitrohumus is reserved for critical areas in need of amendment and/or overseeding and as a mulch in new plantings and flower beds.

The Los Angeles City School District uses about 3,500 cubic yards of steer manure, 500 cubic yards of nitrolized wood shavings and 70 cubic yards of Nitrohumus annually; a total of 4,070 cubic yards of soil amendment. This district maintains about 50% of all school grounds excepting colleges in the LA/OMA study area. It is therefore estimated that at least 8,000 cubic yards of soil amendment are consumed each year by school districts. To capture a large share of the market a sludge product would have to be priced at $3 to $5 per cubic yard, comparable to steer manure. At that price a sludge product could capture about 85% of the market, or nearly 7,000 cubic yards annually.

CALTRANS

In the Los Angeles/Orange County area, CalTrans has solved its trimmings disposal problem by grinding and composting previously discarded organic material (the City of Los Angeles also contributes to this stockpile). This material is then applied to freeway embankments with a blower device. In addition to savings on materials costs, top dressing of this nature contributes to both weed control and water retention.

Since CalTrans attempts to adjust plantings to a specific area, very little replanting and soil amendment is required. The plan is for most plants to remain undisturbed for 15 to 20 years; all new construction is handled by landscape contractors. Consequently, estimates of volumes of materials used are included in that section.

WHOLESALE NURSERIES

In other regions where the marketing consultant has conducted similar marketing studies, the wholesale nursery industry can be divided into field and container varieties. In southern California, however, field nurseries comprise a negligible proportion (perhaps as low as 2% of this industry); in this area nurserymen have chosen the more intensive use of real estate that container technology allows. Although some production is under glass (notably house plants and cut flowers), most container nurseries are open air. Flowers, ground cover, foliage plants, shrubs and trees are cultivated in either plastic, fibre or metal containers of several sizes.

POTTING SOIL INGREDIENTS

There is considerable variety in the types and ratios of materials used by nurserymen in blending the potting mix to be used in their containers. At all nurseries contacted during the current study, the exact formula was considered to be a trade secret; in certain instances it was only after firm assurances of confidentiality that information was made available to this study.

In those container nurseries contacted during the preparation of this report, a potting mix is constructed by combining various organic materials and sand or sandy soil. Redwood shavings, sawdust and fir bark are the most common organic ingredients; proportions range from 25% to 100% organic material. To the agronomist, the functions of each component are many, but basically sand contributes to drainage while organic matter provides mulch for water retention and to facilitate root development. To each potting soil blend is usually added small quantities of lime, gypsum and trace elements, and both fast and slow release chemical fertilizers (e.g., 7-8-9, 12-12-12, 14-14-14); some nurseries add fertilizer in liquid form through drip irrigation systems.

Because organic matter actually consumes nitrogen as it continues to decompose in the soil, additional nitrogen must be provided than would otherwise be needed by the plant for quick and healthy growth. To reduce the amount of chemical fertilizer required in their potting mix, some nurserymen are composting their organic materials to further decomposition before blending. The heat generated by composting also helps to sterilize the material and thereby reduce the nursery's dependence on chemical herbicides.

Estimates of organic soil amendments used in potting mixes by the 300 wholesale nurseries in the LA/OMA study area (3% of total population sampled) are as follows:

Wood by-products	634,500 cu. yds.	97%
Peat moss	18,915	2.9%
Other	75	.01%

CHARACTERISTICS DESIRED

During the course of this study it has become apparent that many of the larger container nurseries have been interested in sludge products for some time. One research director summarized 20 years of experiments with various sludge materials: the presence of heavy metals and all forms of salt are typical characteristics and pose major obstacles to nursery use of sludge products. Some heavy metals interfere with the uptake of nutrients by the plants; certain elements, such as the borates, are toxic to plants. Salinity is high in sludge material, as it is in other animal manures; the presence of all forms of salts in Nitrohumus has prevented its general acceptance as a component of nurserymen's potting mixes. Some nurserymen have considered sludge in small quantities as a possible source of trace elements.

Even with historically negative reviews, nurserymen remain hopeful that a sludge product will be developed that is acceptable for their uses. Nurserymen suggested it might provide a substitute for redwood sawdust, future supplies of which are questionable due to the depletion of redwood stands available to the timber industry, if the material satisfied the following list of criteria: 1) negligible levels of heavy metals; 2) low salinity; 3) slow release of nutrients; 4) retain moisture without remaining soggy; 5) does not solidify in container or in storage; 6) sterile; 7) consistent quality; 8) light weight (an advantage when shipping potted plants); and 9) cost no more than conventional materials, e.g., at $5 to $6 per cubic yard delivered.

POTENTIAL DEMAND

Assuming that a sludge product with the above characteristics were available, the product could be substituted for the sawdust which provides a mulch in container soils and typically composes about 20% of the organic material used in nursery potting soils. The container nurseries sampled during the current study each used an average of 2,178 cubic yards of organic material in 1977;

consumption ranged from 43 to 33,000 cubic yards per year. This represents 25% to 35% of their total potting mix (the remaining 65% to 75% is composed of sand, soil, etc.). Since there are approximately 300 wholesale nurseries in the Los Angeles/Orange County area (of various sizes) a total of 653,400 cubic yards of organic material is consumed annually by this industry.

If the sludge material satisfies nurserymens' requirements concerning salinity and heavy metal content, and at a price comparable to sawdust (about $5.50 per cubic yard) it is estimated that perhaps 20% of customary organics could be substituted by a sludge product; this would result in a market for 130,680 cubic yards of material. *The degree to which the product satisfies nurserymens' demand factors would, of course, ultimately determine rates of substitution.*

TURF FARMS

FERTILIZERS USED

The fertilizer requirements of turf farms are greater than those of golf course fairways: massive applications of high nutrient fertilizer. Generally, 200 pounds of blends of ammonium nitrate and ammonium phosphate containing from 20% to 30% nitrogen (N) are applied to each acre of sod; applications are made every 2 to 3 months of the 6-month growing season. Organic fertilizers have been avoided because of the relatively slow rates of nutrient release and the fact that substantially greater volumes of organic fertilizer would be required to achieve optimum nutrient levels. Forty to sixty pounds of nitrogen are applied each month in the form of concentrated inorganic products. Between 1,000 and 1,500 pounds of 4% N sludge material would be required per acre for equivalent nitrogen application.

THE NEED FOR SOIL AMENDMENTS

A sludge product might, however, be of some use to turf farmers as a soil amendment; it would be especially valuable if some nutrients were also available immediately for plant use. The agronomist at one of the largest turf farms in the country (1000 acres in 3 locations) indicated that his firm is currently looking for an organic product to be worked into some of their fields to relieve compaction. By continuously and completely removing the organic product of a field in the form of rolls of turf, the soil is gradually depleted of its mulchy, water-retaining quality. Organic material is desperately needed in some acreage to regain a texture conducive to healthy root development.

Only about 15% of sod fields are prepared with organics each year. Approximately 40 cubic yards of material are applied to each acre and disced into the soil, resulting in an annual organic amendment volume of approximately 24,000 cubic yards. Currently steer manure is used on rye and bluegrass and chicken manure is used on fields intended for dichondra. The latter grass is more sensitive to salt levels and chicken manure was reported to be less salty. Other materials, such as gypsum, are also under consideration to loosen compacted sandy soil; some turf farms have experimented with sludge, but problems in applying unprocessed material have prevented widespread acceptance. It is estimated by agronomists that as much as 70% of turf farm acreage in the Ventura River delta, Camarillo area, and in Orange County, on which much of the turf grown in the LA/OMA study area is cultivated, could benefit from applications of an organic soil amendment. Only the cost of materials ($3 to $6 per cubic yard delivered) prevents the amendment of more than just the critically depleted fields.

POTENTIAL DEMAND

If a sludge product with a salt content less than steer manure were available and were priced at $5 to $6 per cubic yard approaching the cost of steer manure, it is estimated that such a product would be substituted for about 67% of the organic soil amendment currently used by turf farms serving the LA/OMA study area. Since there are approximately 4,000 acres in turf production in the study area, this would result in an annual market for about 16,000 cubic yards of sludge product (4,000 acres x .15 = 600 x .67 = 402 x 40 cu. yds. = 16,080 cu. yds. per year).

If such a product were priced significantly lower, in the $3 to $5 per cubic yard currently charged for steer manure it might be used to amend more than the 15% of fields now treated annually. Unlike fertilization, amendment of turf acreage is not absolutely necessary, consequently farmers' decisions concerning amendment are subject to immediate economic considerations. For this reason, the absence of the product to test made it impossible to accurately estimate the volume and price relationships which would occur.

U. S. FOREST SERVICE

The Angeles National Forest, unlike others farther north, is primarily a recreational area. Prepared ranges for cattle grazing are not maintained; the only stock grazing is limited to a few sheep allowed to graze on fuel breaks to help manage grasses.

Most of the Angeles is extremely flammable chaparral forest. Since the Forest Service's primary concern is to prevent the chaparral from burning, they have no desire to increase the size of this potential through fertilization.

A potential market exists for a sludge product, however, for use as a soil amendment on 4,000 to 5,000 acres of forest tree plantations (5- to 20-acre stands of pine and fir) and as a mulch material on a few hundred acres annually of cut and fill slopes created by highway construction. Currently no amendments are used in either area, but applications of inorganic fertilizer (e.g., 16-20-0) are made to achieve a nutrient level of 50 pounds of nitrogen per acre. If a sludge product offering at least 5% nitrogen were available, the Forest Service would consider applying it for both its fertilizer and amendment value at a rate of 1,000 pounds (1.5 cubic yards) per acre. This would involve a potential Forest Service market of 6,000 to 7,500 cubic yards annually at a price of no more than $8 per cubic yard in order to be competitive with the cost of labor and materials used in the current fertilization program.

Finally, the Forest Service, in conjunction with private industry and the Bureau of Land Management, is experimenting with the conversion of chaparral to energy. The resins which make manzanita and sage a wildlife threat contribute to their potential for exploitation as a source of heat. The Forest Service is investigating the possibility of a massive project along these lines in the Chino area. A low cost sludge product would be attractive for use as both an amendment and fertilizer in such a project, but estimates of potential demand are unavailable at this time.

CONCLUSIONS

DEMAND PARAMETERS

The features required of a sludge-based soil amendment product by specialty users are outlined below; certain features are more important to some components of the market than others and were discussed in their respective analyses. *All specialty users, however, considered price to be the most important feature affecting demand for the proposed sludge product.* The comparability of the price of a sludge product with the prices of other soil amendments, particularly wood by-products, strongly affects potential sales of the sludge product. Other characteristics which affect the volume of potential sales to one or more components of the specialty market include: uniform particle size; sterility; low salt content; negligible heavy metal content; a texture which retains some moisture but does not solidify; consistent quality; constant availability; delivery; and light weight.

ESTIMATED DEMAND

Table 4.2 summarizes the prices at which sludge products are estimated to be marketable to specialty users and the volumes of sludge products marketable within those price ranges. The volumes estimated to be marketable are given in both cubic yards, the unit of measure customarily used by specialty users, and tons, the customary unit of measure for wastewater treatment agencies. Price ranges are used in many parts of the report, rather than specific prices, partly due to price variations among various suppliers of competitive materials and because volume discounts are a very common pricing practice; the prices shown on Table 4.2 are averages. The ranges of volumes shown for certain user groups primarily reflect uncertainty as to the volume which would be demanded within the given price range. These estimates are dependent on the efficacy of the sludge products as specified in the following sections discussing each of the specialty groups. The stringent demand parameters of some components of the specialty market, primarily wholesale nurseries, must be considered when interpreting Table 4.2.

ELASTICITY OF DEMAND

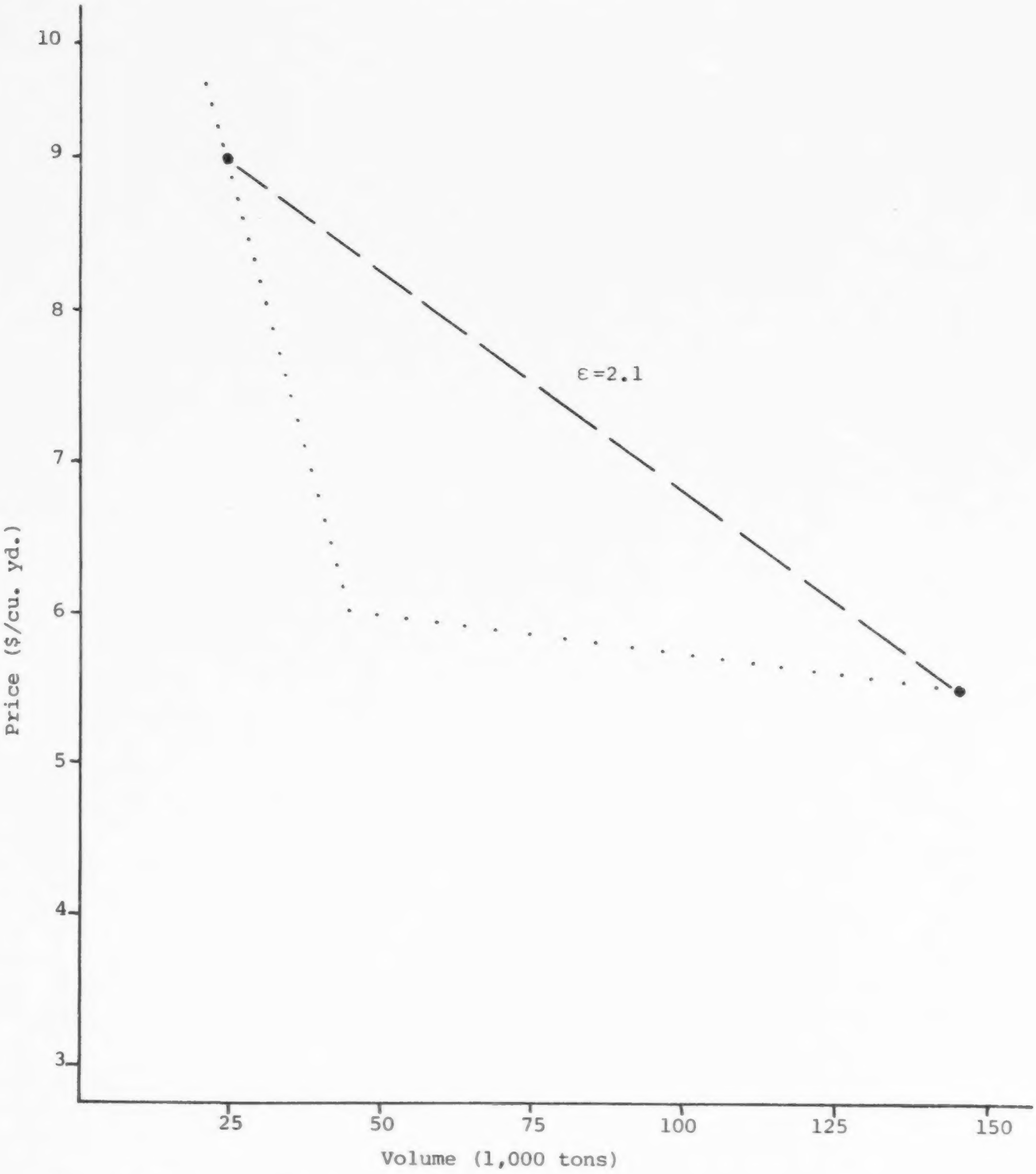
The total demand generated by all specialty markets at the two approximate price levels is shown graphically in Figure 4.1. The figure shows that demand is very elastic in this price range as the percentage increase in volume demanded as the price is lowered from $9 per cubic yard to the $5 to $6 range (or about $5.50) far exceeds the percentage change in price. This means that lowering the price from $9 per cubic yard to $5 to $6 per cubic yard would increase demand enough to generate greater total sales revenue at the lower price than would be generated at the higher price.

TABLE 4.2
ESTIMATED POTENTIAL ANNUAL SALES OF A SLUDGE SOIL AMENDMENT TO SPECIALTY USERS GIVEN PRICE ASSUMPTIONS

	Volume Marketable at $9/Cu.Yd.		Volume Marketable at $5.50/cu.yd.	
Specialty Users	Cubic Yards	Tons	Cubic Yards	Tons
Landscape Contractors	26,000	14,040	78,000-80,000	42,120-43,200
Golf Courses	675	365	5,500	2,970
Cemeteries	21	12	1,100	594
Parks and Public Works Departments	17,179	9,277	22,500-24,750	12,150-13,365
School Districts	140	76	6,800	3,672
Wholesale Nurseries	0	0	130,000	70,200
Turf Farms	0	0	16,000	8,640
U. S. Forest Service	0	0	6,000-7,500	3,240-4,050
TOTAL	44,015	23,768	265,900-271,650	143,586-146,691

SOURCE: Gruen Gruen + Associates

FIGURE 4.1
DEMAND FOR A SLUDGE PRODUCT IN THE SPECIALTY MARKET



SOURCE: Gruen Gruen + Associates

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Interviewees clearly indicated, however, that the main reason for this high elasticity of demand is that a sludge product becomes competitive with wood by-products at the lower price range for the many specialty market uses for which price is the most important characteristic, such as landscape construction. While demand was only measured at two price levels, there was a strong suggestion that the actual demand for a sludge soil amendment could more accurately be portrayed as a kinked curve similar to that shown in Figure 4.1 by the dotted line.

The inference that the true demand curve approximates the dotted line shown in Figure 4.1 has important implications for the pricing of a sludge product to be sold to the specialty market. Pricing the product at more than $6 per cubic yard makes the sludge product uncompetitive with wood by-products on a price basis. In this price range only specialty users for whom a sludge product has other features which are more attractive than those of wood by-products will purchase the sludge product. On the other hand, as the price falls below about $6 per cubic yard, the sludge product becomes more competitive with wood by-products and very large increases in sales may be realized by small decreases in the price. There are therefore two rational pricing strategies for the specialty market: a high pricing strategy to realize large revenues per unit sold at $8, $9 or more per cubic yard; or a low pricing strategy aimed at maximizing sales in competition with wood by-products which currently are priced in the $5-$6 per cubic yard range.

It is believed that the increase in demand for a sludge product which could be generated by lowering its price would not precipitate a substantial decrease in the price of wood by-products. Sawdust in all forms is in increasing demand in other segments of the economy (e.g., energy, fiberboard, fireplace logs, etc.); coupled with decreasing security of supply, it is believed that wood by-products will, if anything, increase in price. Possibly, by the time large-scale sludge processing becomes operational, the price of wood by-products will have risen above today's price; this will tend to increase the volume of a sludge product which could be marketed at a given price level.

FUTURE DEMAND

Since it was not possible to separate the demand for soil amendments for new construction from that for maintenance, it was not feasible to derive specific estimates of future potential sludge product sales from forecasts of the volume of new construction or acres requiring maintenance. While it was not possible to develop a specific forecast, maintenance-related demand for soil amendments is likely to grow as more landscaped areas requiring maintenance are added in the region. On the other hand, the

Southern California Association of Governments' (SCAG) Regional Population, Housing, Employment and Land Use Forecasts: Baseline and Range show that the demand related to new construction is likely to remain approximately constant through 1985 then decline, as the growth of the types of land use which require landscaping is forecast to decline. Given these countervailing trends, it is felt that the estimates of potential annual sludge product sales shown in Table 4.2 are the best available estimate of potential sludge sales in 1990 as well as currently.

POTENTIAL EFFECT ON DEMAND OF REQUIREMENTS RESULTING FROM HEALTH CONCERNS

Two potential actions which the California State Department of Health is considering taking in response to concerns that sludge used could add significant volumes of heavy metals to the human food chain were discussed in the previous chapter. The first involved labeling to discourage use of sludge products on land used for vegetable crops. Labeling would not affect the specialty market since most sales to this market are in bulk. Even a warning transmitted by means other than labeling is unlikely to affect most components of the specialty market as specialty users are not usually involved with vegetable cultivation.

The other possible action involves trying to limit the release of heavy metals from sludge products. It is known that all organic materials including sludge produce acids as they decompose, and it is also known that soils with strong acid concentrations, as indicated by a low pH factor, tend to release heavy metals more rapidly than less acetic soils. Lime is frequently used to raise the pH of acid soils. It has been proposed that lime could be added to sludge products to counteract the effects of the acid they produce as they decompose. The primary effect of adding lime would be to create a product with an initially high pH factor, which, in combination with the naturally high pH factors of southern California soils, could affect the growth of young acid-loving plants. This result could affect the demand of the wholesale nursery component of the specialty market for a sludge product, but appears unlikely to significantly impact the demand of other components.

MARKETING STRATEGIES AND REVENUE ESTIMATES

The purpose of this section is to: 1. draw together the parameters of the specialty market demand for a sludge product described throughout this chapter; and 2. draw together the estimates of elasticity of demand derived from the estimates of demand ar various price levels developed for each segment of the specialty market; in order to 3. identify the factors most likely to determine the long-run success of a sludge marketing program; and 4. estimate the revenue a producer of a sludge product could expect to receive from a marketing program.

Clearly price is the most important characteristic. The demand estimates show that demand is very elastic with respect to price within the price range examined; that is, price will have a great impact on the amount of the product which can be marketed. But the parameters of the specialty market demand indicate that another aspect, which could be called service, is also of extreme importance to specialty users of soil amendments. The marketer of the sludge product must provide a sales staff which calls on potential specialty users, particularly on landscape architects, since landscape construction (for which architects specify materials) is a major component of this market. These sales/service calls must be made on a regular basis to continually provide information and advice on the most effective uses of the product. In addition to the sales staff, the marketer's service must include warehousing and delivery arrangements capable of filling just about any size order on a day's notice. A third factor of importance is that the sludge product must have the desired characteristics and have them throughout every batch delivered, not just on the average.

These factors provide important guidance in designing a marketing program. The importance of product consistency as well as concerns regarding product liability indicate that it would be in the sewage treatment agencies' long-term best interest to produce the basic sludge product (a composted or heat-dried sludge) themselves, either at a central location or at the separate treatment plants. On the other hand, this and previous studies have indicated a private firm would be the most effective organization to provide the service necessary to maximize long-term sales as long as the firm is provided with the appropriate incentives. These incentives could most effectively be provided if the agency or agencies are dealing with only one marketing firm. A broker, whose function is to communicate between many buyers and sellers of similar products, would not be appropriate in this role.

Estimates of the ranges of prices the agency or agencies might receive from the marketing firm are shown in Table 4.3 and in Figure 4.2. The sales values shown on the first line of the table are those at which specialty market demand is estimated. The $9.00 per cubic yard sales price is the closest to the current sales price of Nitrohumus, the sludge product marketed in the LA/OMA study area by the Kellogg Supply Company. The $5.50 price is approximately comparable to the price of the wood by-products most commonly purchased by specialty users. The processing, storage and sales costs estimates are based on costs reported by the Kellogg Supply Company, as are the delivery costs, though Kellogg uses contract truckers rather than operating its own bulk delivery fleet. Profit was judgmentally estimated by Gruen Gruen + Associates. The resulting ranges of sales revenue estimates partially reflect potential variations in marketing costs between new versus established products. The producing agency could expect to receive less (or pay more) when it is offering a new product than

TABLE 4.3

ESTIMATED PRODUCER'S REVENUE FROM SALES OF A SLUDGE PRODUCT IN THE SPECIALTY MARKET

Sales value ($/cu. yd.)	$9.00	$5.50
Estimated processing, storage and sales costs and profit or service charges	5.20-7.00[1]	3.50-4.70[1]
Delivery costs	2.00	2.00
Resulting potential sales revenue to producer	0.00-1.80	0.00-(1.20)

SOURCE: Gruen Gruen + Associates' Interviews with Existing Retailers and Distributors of Sludge Products

1. Assumes 40% of costs are variable by volume.

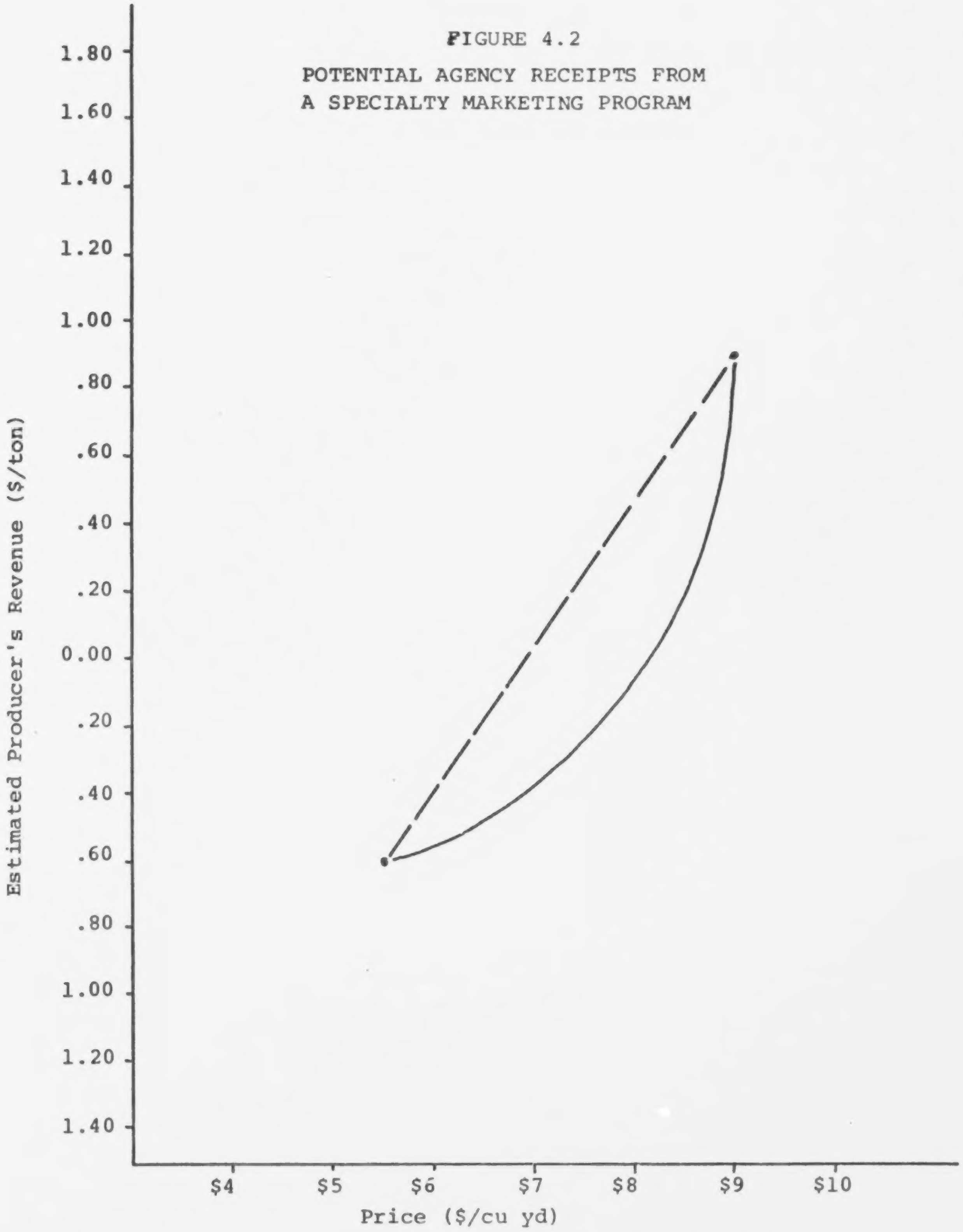


FIGURE 4.2

POTENTIAL AGENCY RECEIPTS FROM A SPECIALTY MARKETING PROGRAM

SOURCE: Gruen Gruen + Associates

an established one, but as the product becomes established in the market the producer may be able to receive more (or pay less) moving along the curve shown in Figure 4.2 as the marketer's efforts to obtain given levels of sales should decrease as user recognition of the product increases. This process of establishing a new product would likely require subsidization in the first few years of the marketing program, during which the marketing firm should be contractually encouraged to reinvest a large proportion of its sales revenue in sales/service efforts. The need to encourage this heavy investment in product development could be somewhat alleviated by having the Kellogg Supply Company market the product of all the producing agencies as an established product, though increasing Kellogg's volume substantially would require the firm to initially invest significant effort in capturing a larger share of the specialty market.

Encouraging the marketing firm to offer the sludge product at the lower price is estimated to require an on-going subsidy or at the best result in a break-even situation, while the higher price tested is expected to generate some positive revenue for the producing agency. Marketing a product at the lower price in order to dispose of greater volume would be a desirable strategy if the production and subsidy costs together are lower than the costs of otherwise disposing of the additional sludge. While the producing agencies should encourage the marketing firm to reinvest sales revenue in initially developing a strong sales/service program, whether the product is marketed as a new or established product, the potential for moving the demand curve by differentiating the product is not great. Therefore, the need to market the product at the higher price in order to generate revenue to undertake such an effort and maintain the product's image is not as compelling as it is for the home and garden market. In fact, the apparently growing demands for wood by-products exercised by those using it for energy conversion and particle board manufacturing is much more likely to cause some shift of the specialty market demand curve than any efforts at differentiating the sludge product.

CHAPTER 5

AREA-SPECIFIC AGRICULTURAL MARKETS

INTRODUCTION

PURPOSE OF THIS ANALYSIS

The report on Task 2 of the marketing study, titled Potentially Marketable Sludge Products, characterized the marketing of sludge products as fertilizers or soil amendments for commercial agricultural uses as being generally less promising than other marketing options. However, three geographic areas which seemed to warrant further study were identified because of their proximity to potential processing sites proposed with respect to the long distance transport alternative being studied by the LA/OMA Project staff and consultants.

This sludge management alternative involves long distrance transportation of sludge via pipeline to a remote site where land intensive sludge treatment processes such as air drying and storage could be conducted away from the populous Los Angeles basin. Since one of the impediments to marketing sludge to commercial agriculture users identified in Task 2 was transport costs, and this impediment would be overcome for areas close to the treatment sites under this alternative, further investigation seemed warranted where any significant demand for organic materials existed or appeared likely to exist.

Initially, three areas where significant demand was found to exist were the Coachella Valley of Riverside County, the Antelope Valley of Los Angeles and Kern Counties, and the southern portion of the San Joaquin Valley of Kern County. LA/OMA Project conducted further potential site investigations that resulted in the identification of sites in the Antelope Valley and the region surrounding Barstow in San Bernardino County. In addition, the investigations led to the elimination of further consideration by the LA/OMA Project of the San Joaquin Valley for a processing site.

Because of this, only the Coachella and Antelope Valleys were initially studied as part of this Task 3 effort. Investigations of the agricultural market in the region near Barstow was begun later to reflect the detailed consideration of additional distant processing sites in that area.

APPROACH

Research into these two potential area-specific markets for sludge products was limited to interviews of local experts and reference to published sources of information such as crop reports. Agricultural advisors for the two counties primarily concerned (San Bernardino and Los Angeles) were first interviewed to obtain an overview of agriculture and related soil and climatic conditions in the area concerned. Names of principal growers were also obtained from the advisors. Fertilizer dealers were identified through the local telephone books and the California Department of Agriculture's list of licensed fertilizer dealers and manufacturers. The dealers were interviewed in order to obtain an overview of the types of fertilizers and soil amendments currently being used in the area and any trends in such use which might be significant. Growers of each major type of crop identified in the county agricultural commissioners' annual crop reports were then interviewed to obtain the users' perspective. Additional sources such as irrigation districts were consulted as required.

Since the purpose of considering the long distance transport alternative was to minimize treatment costs, only the combination of air drying and composting the sludge was considered. The resulting product was assumed to be at least 60% solids, approximately 1.5% (of dry weight) nitrogen and about 2.5% phosphorus.

THE BARSTOW AREA MARKET

INTRODUCTION

Barstow is located in about the western center of San Bernardino County on the western edge of the Mojave Desert. The area dealt with in this analysis includes the urban areas of both Barstow and Victorville and is bounded by the San Bernardino Mountains on the south, and largely undeveloped land, much of which is in military reservations, to the west and north, in addition to the desert to the east. Scattered small mountain ranges divide the area and agriculture is further dispersed by the limited availability of water from underground rivers, the only source of water in the area. Soils are very sandy.

Table 5.1 shows the agricultural acreage by crop type in the Barstow area in 1977. There has been steady growth in the acreage in agricultural production in recent years. The supply of water has not been a significant constraint to this growth.

CLASSIFICATION OF FERTILIZERS, SOIL AMENDMENTS AND ORGANIC MATERIALS

California state laws divide agricultural materials into two classes: fertilizers, which must contain a total of more than 5% (by volume) of any combination of the three primary plant nutrients, nitrogen (N), phosphorus (P), and potassium (K); and soil amendments, which are defined as all other materials applied to the land.

Growers, on the other hand, seem to categorize materials into three groups. First there are commercial fertilizers which are manufactured and available in a variety of mixes of N, P, and K and in dry or liquid (or occasionally gaseous) forms. The commercial fertilizers commonly used typically have combined nutrient contents of at least 20% or more. Soil amendments are a second group of products, purchased primarily to alter the pH of the soil such as gypsum or lime, or to add trace elements such as iron or zinc. The third group of products consists of organic materials such as manures and sludge. Organic materials generally contain from zero to 10% total combined nutrients and frequently contain less than the 5% necessary to be legally classified as fertilizers. The most commonly used organic materials are steer manure and poultry manure.

Growers purchase generally organic materials because they provide both nutrients and organic matter in one application. Organic matter provides humus which retains moisture. Sandy soils have the most need for humus as they naturally contain little organic matter so that water applied to them drains away rapidly before crops can absorb much. Despite the obvious need for organic material in sandy soils its economic value has historically been low since: 1. it decomposes so that more must be added frequently; and 2. large volumes are required to have significant effects so

TABLE 5.1
AGRICULTURAL ACREAGE PRODUCING SPECIFIC CROPS IN THE BARSTOW AREA

Major Crops	Acreage in Production in 1977
Hay - Alfalfa	17,825
- Other	1,650
Grains - Barley	150
- Oats	130
- Wheat	522
Seed - Alfalfa	182
Sudan Grass	1,445
Fruits, Nuts and Vines	196
Sunflowers	60
Vegetables	147
Lint Cotton	1,100
Irrigated Pasture	2,970
Dry Range	16,778
Total	43,155

SOURCE: San Bernardino County, Department of Agriculture, Annual Crop and Livestock Report 1977 and Richard A. Campana, Assistant Commissioner, San Bernardino County, Department of Agriculture.

that high transportation and spreading costs are incurred. *It is not common, except in areas where soils are extremely sandy, for growers to purchase a product only for its organic matter content.*

CURRENT USE OF ORGANIC MATERIALS IN THE BARSTOW AREA

The primary crop grown in the Barstow area is alfalfa, which requires substantial nitrogen and phosphorus fertilization. Most growers in the area use a 16-20-0 commercial fertilizer to satisfy these nutrient requirements. Soils in the area have little or no natural humus to retain water so that the demand for an organic material is relatively strong.

There are no local supplies of organic material. Growers in the Barstow area primarily purchase steer manure from dairy operators in the Chino area about 80 miles away. The steer manure is delivered to the Barstow area growers, most of whom have their own spreading equipment. The current price being paid for steer manure by Barstow area growers is about $5 per ton, which is equal to the cost of transporting the material from Chino to the Barstow area. The Chino dairy operators, for whom the manure is a major waste disposal problem, are paying or absorbing the cost of collecting the manure and loading it onto the trucks.

Unfortunately there is little data concerning the volume of organic materials currently used. The California Department of Food and Agriculture reports the tonnage of fertilizers and agricultural minerals (such as gypsum and lime) sold annually and quarterly by county; however, these reports do not include most organic materials, since no tonnage taxes are assessed on manures. More than 50% but less than 100% of the acreage in alfalfa production is receiving applications of five to seven tons of alfalfa per acre per year according to Barstow area growers. One could thus infer that between 44,600 and 124,800 tons of steer manure is being purchased by Barstow area growers.

While most growers interviewed in the course of the study indicated an interest in obtaining more steer manure, they also said they were not interested in paying any more than about the $5 per ton they currently pay. Barstow area growers value the steer manure only for its humus content; they do not count its nitrogen content (about 1.5% to 2%) in estimating their fertilizer requirements as they feel the amount is too small and the release rate too slow and erratic to be relied on.

Some Barstow area growers have substituted air-dried sludge obtained from the San Bernardino treatment plant for steer manure in recent years. The sludge was found to be an adequate substitute so long as it was ground into particles less than one inch in diameter. The San Bernardino sludge which has only been air tends to be lumpy. If it is directly applied to the soil, the larger particles will remain on the surface rather than mixing with the soil.

THE DEMAND FOR A SLUDGE PRODUCT IN THE BARSTOW AREA

An air-dried, stabilized sludge product would be substitutable for steer manure, given that it has a uniform consistency and does not have a high heavy metal content. It would probably be necessary to pass the material through a screen to assure a consistency acceptable to Barstow area growers. The growers are not particularly conscious of the heavy metals content of sludges. However, the Environmental Protection Agency publication, "Municipal Sludge Management: Environmental Factors; Technical Bulletin" published in the Federal Register November 2, 1977, suggests total cumulative heavy metal loadings which may serve as a guideline for treatment agencies considering applying sludge to land or marketing a sludge product for that purpose. The practical impact of these guidelines would be to limit the number of years which a sludge product could be applied to any given parcel of land depending on the amount of the sludge product applied per acre and the concentration of heavy metals present in the sludge product. *Any significant limitation on the duration of use of a sludge product, even a 15- to 20-year limit, is likely to substantially reduce or completely eliminate its marketability in the Barstow area.*

While sludge may contain more plant nutrients than steer manure (primarily more phosphorus), Barstow area growers indicate the same uncertainty regarding both the amount and release rate of nutrients from sludge as they do for nutrients from steer manure. The result is that the growers are not likely to be willing to pay any more for the sludge than they currently pay for manure, or about $5 per ton. The direct competition between these two materials also suggests that there could be some competitive price effects. Some of the manure from the Chino area which is currently being hauled to the Barstow area could likely be disposed of locally in Chino or hauled to other areas such as the Coachella Valley where demand for organic material exists, but the volume involved and the fact that the manure must be disposed of somehow would lead one to conclude that there could be some flexibility in the price of manure. The amount of flexibility does not seem likely to be great, but this factor should be recognized when selecting an overall sludge marketing strategy.

Growers indicated that if enough material were available at about $5.00 per ton they would apply about seven tons per acre to all of the acreage in alfalfa production in the Barstow area. The other crops shown in Table 5.1 are either planted on the same land used seasonally for alfalfa production or are not likely to have organic material applied to them. It is estimated that a sludge product would be used as a substitute for steer manure on 75% to 100% of the land in alfalfa production. Demand, based on 1977 crop acreage, could therefore be estimated at 93,600 to 124,800 tons per year.

It is estimated that the acreage in alfalfa production grew at about 2.4% annually during the 1970 to 1977 period. There are no indications that such a growth rate could not be sustained in the future through the marketing forecast horizon of 1990. Of course fluctuations in the market price of alfalfa could cause yearly fluctuations in the acreage in alfalfa production, but the long-run trend could be expected to approximate the past growth assuming there are no major unforeseen occurrences. Table 5.2 shows the estimated demand for a sludge product based on 1977 crop acreage and projected demand for 1980, 1985 and 1990 assuming the acreage in alfalfa production continues to grow at an annual rate of 2.4%.

TABLE 5.2
ESTIMATED POTENTIAL MARKET PENETRATION AND ANNUAL SALES OF A SLUDGE PRODUCT IN THE BARSTOW AREA AT $5.00 PER TON

Year	Acreage in Alfalfa Production	Estimated Application Rate (tons/acre)	Estimated Percentage of Acreage to Which Sludge Would be Applied	Estimated Product Sales (tons)
1977	17,825 (estimated)	7	75% - 100%	93,600-124,800
1980	19,140 (estimated)	7	75% - 100%	100,500-134,000
1985	21,550 (estimated)	7	75% - 100%	113,100-150,900
1990	24,260 (estimated)	7	75% - 100%	127,400-169,800

SOURCE: Gruen Gruen + Associates

THE ANTELOPE VALLEY MARKET

INTRODUCTION

The Antelope Valley is a roughly oval valley with a diameter of from 30 to 50 miles straddling the borders of Los Angeles and Kern Counties just west of San Bernardino County. Palmdale and Lancaster are the major settlements located in the south center of the valley and Rosamond is located in the north center.

Table 5.3 on the following page shows the acreage in agricultural production by major crops for the years 1972-1976 for the portion of the valley in Los Angeles County. Unfortunately, no comparable data is available for the portion of the Valley in Kern County; however, an estimate of 8,000 to 10,000 acres was obtained from an official of the U. S. Department of Agriculture in Bakersfield. This official also stated that only three crops (alfalfa, sugar beets and dry onions) were grown in the area and would be grown in roughly the same proportions as in the Los Angeles County portion of the valley. The resulting ranges of judgmentally estimated acreage by crop type are also shown on Table 5.3.

THE SUPPLY OF WATER

The acreage in agricultural use grew through 1975 due primarily to the availability of irrigation water from the California Water Project. One branch of the California Aqueduct passes through the Antelope Valley on its southwest side. The Antelope Valley-East Kern Water Agency (AVEK) which serves the area is entitled to purchase up to 138,400 acre-feet of water annually from the aqueduct. The agency currently sells approximately 7,000 acre-feet to municipal and industrial users and 91,000 to 92,000 acre-feet to agricultural users at about $29 per acre-foot for a total of 98,000-99,000 acre-feet. AVEK estimates there is demand for an additional 9,000 to 13,000 acre-feet of irrigation water at $29 per acre-foot but that these users are located too far from the current distribution lines to make serving them economical.

AVEK estimates that approximately 18,000 to 23,000 acre-feet of water are obtained by municipal and industrial users from wells and 83,000 to 89,000 acre-feet are obtained by agricultural users from wells for a total of 101,000 to 112,000 acre-feet. The natural recharge rate of the underground water table is estimated at only 56,000 acre-feet annually. As a result of overuse, the water table has been dropping an average of five to eight feet per year in recent years. The cost of using water from wells has therefore been increasing as wells must be deepened occasionally and the cost of pumping the water to the surface increases.

The current use of irrigation water could nearly be sustained at the natural recharge rate of well-water use if the total entitlement from the aqueduct were used. The total supply of water would then be equal to 194,400 acre-feet whereas current use is 200,000

TABLE 5.3
MAJOR CROPS AND ACREAGE IN AGRICULTURAL PRODUCTION IN THE ANTELOPE VALLEY

Crops:	Alfalfa	Grains	Sugar Beets	Dry Onions	Others	Total
Los Angeles County Portion:						
Year: 1972	22,400	15,500	1,500	80	3,176	42,656
1973	21,400	17,400	1,220	240	2,760	43,020
1974	19,800	22,500	1,070	250	3,295	46,915
1975	19,000	26,200	1,200	700	2,943	50,043
1976	20,000	11,000	1,870	1,200	2,815	36,885
Estimated Kern County Portion:						
Year: 1972-75			Not Available			
1976	6,000-7,000	--	1,000-1,500	1,000-1,500	--	8,000-10,000
Total Los Angeles and Kern Counties						
Year: 1976	26,000-27,000	11,000	2,870-3,370	2,200-2,700	2,815	44,885-46,885

SOURCES: "Plant Crop Reports - Antelope Valley Area", Los Angeles County Agricultural Commissioner. U. S. Department of Agriculture, John Guerard, Farm Agent, Bakersfield.

to 210,000 acre-feet, leaving a shortfall of only 5,600 to 15,600 acre-feet. This is likely to happen as the increasing cost of well water encourages the further development of the AVEK distribution system, assuming the price of aqueduct water remains relatively constant.

However, the price of water from the aqueduct system will remain constant only through 1982. A large component of the cost of water from the aqueduct may be attributed to the cost of the energy needed to lift the water to the elevation of the Antelope Valley, which averages 2,500 feet above sea level. In fact, it is estimated that about $15 of the $29 charged users of aqueduct water in the Antelope Valley is attributable to energy costs. The California Water Project purchases electrical energy from utilities at rates specified in multi-year contracts negotiated prior to the "energy crisis". The cost of generating electricity has increased substantially since these rates were negotiated and it is expected that these increased costs will be reflected in new energy purchase contracts which will be negotiated to replace the current contracts which expire in 1982. It is estimated that the energy component of the aqueduct water price in the Antelope Valley may increase from $15 to $75 to $80, raising the total cost of aqueduct water from $29 to about $90 to $95 per acre-foot, an increase of over 200%. This dramatic increase will affect all users of irrigation water from the California Aqueduct, but it will affect growers in the Antelope Valley the most severely as the prices charged are related to the elevation of the users and the Antelope Valley is the highest area on the aqueduct.

It is impossible to estimate the impact of such an occurrence on agricultural production in the Antelope Valley under the scope of this sludge market analysis. The impacts will depend on many factors such as the future sales values of each crop which could potentially be grown in the valley and their associated production costs other than irrigation water; however, it seems likely that the acreage in agricultural production will decline somewhat. It is apparent that the previous growth of agricultural production in the valley halted in 1975 and little growth is likely to occur prior to 1982 or 1983 when the price of water under the new energy contracts will be established since the risk associated with investing in the preparation of land for agricultural use is quite high under these circumstances.

PARAMETERS OF THE DEMAND FOR ORGANIC FERTILIZERS

Alfalfa and some grain (primarily wheat) growers in the Antelope Valley value organic material primarily for its phosphorus content. These growers do not value the nitrogen content of organic materials very highly. They also desire organic material, although their need for organic material is not so strong that they would purchase a material only for its organic content as opposed to its nutrient content. Alfalfa and grain growers consider commercial phosphorus fertilizers (particularly single-super phosphate) to be quite competitive with organic materials. They are therefore not willing to pay any more per unit of nutrient for an organic material than they would for a commercial fertilizer and apparently would prefer to pay less. Poultry manure sells locally for about $8.25 per ton; assuming it contains 35 pounds of phosphorus per ton, a value of 24¢ per pound of phosphorus can be inferred while single-super phosphate, a commercial phosphorus fertilizer, sells for at least 25¢ per pound of phosphorus.

Growers in this area are only willing to purchase an organic material such as poultry manure on a delivered and spread basis. The organic material dealer is therefore selling a service as well as a product in this market.

Alfalfa and grain growers in the Antelope Valley are also sensitive to limitations associated with the heavy metals content of sludge, although alfalfa and grains have a small metals uptake and most of the alfalfa crop is not consumed by humans. However, some growers used dried sludge from the sludge lagoon in Lancaster in past years. Recent tests showed relatively high concentrations of lead in grain crops; therefore, growers are aware of the heavy metals associated with some sludges and will not use a product with a high concentration of heavy metals.

Sugar beet growers use significant volumes of nitrogen fertilizers but would not use organic materials. The sugar beets will not develop a high sugar content if nitrogen is still available in the soil; therefore, sugar beet growers want fertilizers which release their nitrogen content very rapidly, more rapidly than even poultry manure. Most sugar beet growers use commercial fertilizers as a result.

Dry onion growers have also used commercial fertilizers in the past because they typically lease land which they cultivate for only two years, then move on to another site. This is done to avoid "pink root" disease, but the result is that the long-term benefits of organic materials have little attraction for the onion grower. Fumigation is being used experimentally in order to prevent pink root and has reportedly been successful for growers of green onions in other areas; however, the cost is approximately $150 per acre, which is prohibitive for Antelope Valley dry onion growers. Growers were not able to forecast the cost at which fumigation would become feasible because of the uncertaintly associated with irrigation water and other cost items.

The remainder of the crops grown in the Antelope Valley consist of various fruits, nuts and vegetables. These crops primarily need nitrogen fertilizers. Due to the low demand for organic content, commercial nitrogen fertilizers also compete quite effectively with organic sources of nitrogen. Because of the uncertainty associated with the release of nitrogen by organic materials they must be substantially discounted from the price of commercial fertilizers per unit of nitrogen in order to sell at all.

THE CURRENT USE OF ORGANIC MATERIALS

There are no significant local supplies of steer manure in or near the Antelope Valley. Because of the relatively small number of acres producing crops for which an organic material containing nitrogen might be demanded (steer manure has very little phosphorus), there are very little, if any, sales and applications of steer manure in the valley.

There is some locally produced poultry manure, but most of the poultry manure used in the Antelope Valley has usually come from the San Bernardino-Yucaipa area. In recent years users from other areas who value poultry manure for its nitrogen as well as its phosphorus content have been willing to pay more than Antelope Valley growers and have absorbed most of the San Bernardino-Yucaipa area's production. In fact, some of the poultry manure produced in the Antelope Valley was sold to users in western Kern County and in Ventura County in 1977. This was partially the result of a decline in the price of alfalfa in 1977 and partially due to a decline in both the acreage and price of wheat produced in 1976.

As mentioned previously, some air-dried sludge has also been used by growers in the Antelope Valley in the past. The sludge was obtained from a lagoon adjacent to the Lancaster treatment facility and delivered and spread by local manure dealers on a contract basis. It was found to be hard and lumpy and its nutrient value was not well known. Analyses of grains grown on crops fertilized with the sludge have also reportedly shown high concentrations of lead.

ESTIMATED DEMAND FOR A SLUDGE PRODUCT IN THE ANTELOPE VALLEY

The primary market for a sludge product in the Antelope Valley would be as a phosphorus fertilizer for use on alfalfa and some grain crops. The characteristics of the sugar beet and dry onion crops discussed previously indicate it is unlikely that growers of these crops would use a sludge product in the foreseeable future. Because of the relatively low demand for organic matter and the low nitrogen content of the sludge product, it is unlikely that growers of the various other small crops grown in the valley would purchase a sludge product for use as a nitrogen fertilizer.

Alfalfa and grain growers interviewed in the Antelope Valley area indicated they would be willing to pay from 50% to 100% (with a mean of 75%) of the per unit price of phosphorus in commercial fertilizers for phosphorus in the sludge product.

Assuming the sludge product contains 50 pounds per ton of phosphorus and the current value of phosphorus in commercial fertilizers is 25¢ per pound, then the price growers are estimated to be willing to pay for the sludge product (at 75% of the commercial phosphorus price) is about $9.40 per ton on a delivered and spread basis.

At this price it was judgmentally estimated that the sludge product would be applied to between 50% and 85% of the acreage in alfalfa and grain production in the Antelope Valley. It was the consensus of growers that the sludge product would be applied to at least 50% of all alfalfa and grain acreage at the $9.40 price, but that the lower phosphorus requirements of grains other than wheat would militate against use of the sludge product on these crops, which currently comprise about 15% of the total alfalfa and grain crop acreage.

It is estimated that the sludge product would be applied at a rate of approximately two tons per acre. This application rate is based on average crop nutrient demand estimates which show alfalfa and wheat requirements of 80 pounds of phosphorus per acre. It is assumed two tons of the sludge product would provide 100 pounds of phosphorus per acre, allowing a margin for some inconsistency in the product.

The resulting estimate of potential annual sales of the sludge product in the Antelope Valley, based on estimated 1976 crop acreages, is shown on Table 5.4 on the following page. Crop acreage does not seem likely to grow significantly and may decline between 1976 (the latest available acreage data) and 1983 when the price of irrigation water will be changed; therefore, the estimate shown in Table 5.4 would be valid through 1982, but the volume of sales may tend towards the lower end of the range shown during this period. It was found to be impossible to forecast demand for the sludge product in this area from 1983 on due to the magnitude of the expected change in the price of irrigation water.

TABLE 5.4

ESTIMATED POTENTIAL MARKET PENETRATION AND ANNUAL SALES OF A SLUDGE PRODUCT IN THE ANTELOPE VALLEY BASED ON ESTIMATED 1976 CROP ACREAGES AT APPROXIMATELY $9.40 PER TON

Crop Type	Estimated 1976 Crop Acreage	Estimated Average Application Rate (tons/acre)	Estimated Percentage of Acreage to Which Sludge Would be Applied	Estimated Sludge Product Sales (tons)
Alfalfa and Grain Crops	37,000-38,000	2	50% - 85%	37,000-64,600
Total				37,000-64,600

SOURCE: Gruen Gruen + Associates

CONCLUSIONS

THE MAGNITUDE AND CHARACTERISTICS OF DEMAND

There is significant demand for organic material in the Barstow area primarily because of the very sandy soils found there. Steer manure is currently satisfying much of this demand, but has to be transported into the area an average distance of about 80 miles from the Chino area. While usually in short supply, growers are nevertheless willing to forego its use rather than pay more than about the $5.00 per ton cost of transporting the steer manure into the area. A sludge product could compete effectively with steer manure in this market if: it were priced at about $5.00 per ton or approximately the price of steer manure; it is composed of particles not more than one inch in diameter so that it will mix into the soil easily; it is sold on a delivered basis by a reputable dealer; and its application is not significantly limited by regulation associated with its heavy metal content. Given that the above conditions are satisfied, potential sales are estimated at from 93,600 to 124,800 tons annually based on 1977 crop acreages. If crop acreages continue to increase at the current rate of about 2.4% per year, demand in 1990 is estimated at from 127,400 to 169,800 tons annually.

In Antelope Valley there is little demand for sludge for its organic content as the soils are not as sandy. There is some demand for an organic phosphate fertilizer. Some of this demand is currently being satisfied by poultry manure. But poultry manure must be transported into the area and much of the remote supply is being bid away from Antelope Valley growers by growers in other regions who value its nitrogen as well as its phosphorus content. There are no significant local supplies of steer manure and demand is low because of its low phosphorus content. An air-dried, composted sludge product could compete effectively in this market if: it is priced at around $9.40 per ton (proportionately 75% of the price of a unit of phosphorus in commercial fertilizers); it is sold on a delivered and spread basis by a reputable dealer; and it does not have a high heavy metals content. Given the above conditions, potential sales of such a sludge product are estimated at between 37,000 and 64,600 tons annually based on 1976 crop acreages in the Antelope Valley. Sales are likely to tend towards the lower end of this range by 1982 when an over 200% increase in the cost of irrigation water supplied by the California Water Project is expected to take effect. Demand after 1982 cannot be accurately forecast because of the uncertainty associated with such a significant price change in a primary input to agriculture in the Antelope Valley.

MARKETING STRATEGIES AND REVENUE ESTIMATES

The concerns regarding product quality discussed previously in this chapter and the consideration of product liability mentioned in previous chapters again suggest that the wastewater treatment agency or agencies involved in serving one of the agricultural markets should produce the compost to be marketed.

Either of these agricultural markets is going to require significant marketing effort if sales are to be maximized in the long run. Users in both areas have had previous generally negative experience with the use of sludge products. Considerable information must be presented on an ongoing basis to growers both to overcome knowledge based on past experiences and to assist growers in using the product so that maximum benefits are realized. Experience indicates that a local private marketing firm would be the most successful at this type of effort.

Estimates of the ranges of prices the agency or agencies might receive from a marketing firm operating in either of these markets are shown in Table 5.5. The prices shown on the first line are those at which the sludge product was estimated to be competitive with the products currently being used in these markets. Only one price is shown for each market as it was found that demand was inelastic at prices substantially above and below those of the competitive products; that is, at prices higher than those of the competitive products demand is nearly zero and at prices below those of competitive products demand expands very slowly, if at all. The processing, storage and sales costs and profit or service charges shown on the second line of the table were estimated based on data gathered in Gruen Gruen + Associates' interviews with existing distributors and dealers in the Los Angeles, San Francisco and Portland regions. The variation in unit costs reflects the higher volume of sludge product marketable in the Barstow area. The estimate of spreading costs was also based on interview data, but pertains only to the Antelope Valley market as Barstow area growers tend to own their own spreading equipment. Local delivery cost estimates are based on the LA/OMA Project transport cost estimate of 22¢ per one-way ton-mile, assuming an average haul of about ten miles. The resulting estimated ranges of potential producer receipts are shown on the fifth line. If a processing site were located in the Antelope Valley the producing agency could receive from 20¢ to $2.20 per ton of sludge marketed locally while the agency producing a sludge product at a Barstow area site might have to subsidize the marketing firm by as much as $1.20 per ton or could receive as much as 80¢ per ton.

The last two lines in Table 5.5 deal with potential agency receipts if the sludge product were actually produced in the LA/OMA study area and transported to either or both of the agricultural markets. This could be considered in order to maximize potential sales of a sludge product. For this analysis it was assumed the marketing firm or firms would be located in the market area or areas to be served, but would pick up the sludge product at the production site or sites and deliver it directly to the users. Again the LA/OMA transport cost estimate of 22¢ per one-way ton-mile has been used and estimated average transport distances of 85 miles to the Antelope Valley and 120 miles to the Barstow area

TABLE 5.5
ESTIMATED PRODUCER'S REVENUE FROM SALE OF A SLUDGE PRODUCT

Markets	Antelope Valley	Barstow Area
Sales Price:	$9.40 per ton	$5.00 per ton
Estimated processing, storage and sales costs and profit or service charge:	$3.00-$5.00	$2.00-$4.00
Spreading cost:	$2.00	--
Estimated local delivery cost:	$2.20	$2.20
Estimated range of annual producer receipts if sludge processed in market area:	.20-$2.20	($1.20)-.80
Estimated delivery cost from the LA/OMA study area:	$18.70	$26.40
Estimated range of annual producer receipts if sludge transported from LA/OMA study area:	($14.30)- ($16.30)	($23.40)- ($25.40)

SOURCE: Gruen Gruen + Associates Interviews with Existing Retailers and Distributors of Sludge Products.

were used. The resulting estimates show that the producing agency would have to subsidize the Antelope Valley marketing firm at a rate of from $14.30 to $16.30 per ton and the Barstow area firm at a rate of from $23.40 to $25.40 per ton.

CHAPTER 6

DESIGNING AND IMPLEMENTING A MARKETING STRATEGY

This chapter brings together the analyses of the separate markets presented in the three previous chapters in order to identify the factors which the marketing analysis indicates are important in terms of both choosing an overall marketing strategy and implementing a marketing program.

CHOOSING AN OVERALL MARKETING STRATEGY

There are a wide range of sludge marketing strategies which could be pursued in terms of the markets to be served and the volume and revenue goals to be established. Three strategies are outlined in Table 6.1. At one extreme would be a strategy which practically ignores price and cost considerations in an effort to maximize sales, with the goal of marketing all the sludge product which could be produced in the LA/OMA project area. Since potential 1990 sludge compost production in the project area amounts to 268,600 tons, this strategy implies that the specialty, home and garden, and one of the agricultural markets would be served and a low pricing strategy followed in all markets. This strategy would generate potential sales of 282,800 tons, or about 105% of total potential production.

At the other extreme would be a strategy aimed at serving only those markets where sales revenue is projected to exceed marketing and distribution costs. Such a strategy might well concentrate marketing of a sludge product on the home and garden market and the specialty market at relatively high prices, such as the higher prices shown on Table 6.1 (or even higher). This strategy would preclude transporting a sludge product to the agricultural markets. Pursuit of this strategy is estimated to result in the marketing of no more than 27% of the 1990 sludge production, requiring disposal or some other nonconflicting use of the remainder of the sludge. The outcomes of these three strategies in terms of the volume of sludge potentially marketable and potential agency receipts is shown in Figure 6.1.

COST

There are a number of factors which should be considered when choosing an overall marketing strategy. A prime concern, of course, will be the net cost per unit of sludge marketed in comparison to the costs of other means of sludge disposal. The estimates of the revenue the public agency producers of a sludge product could potentially realize, which are developed in the preceding chapters, clearly indicate that sales revenue would never cover the production costs of the sludge product and in many cases may well require subsidization of the marketing and distribution costs, either temporarily or permanently. The goal is to minimize the overall cost of disposing of the sludge to be produced in the LA/OMA study area.

TABLE 6.1

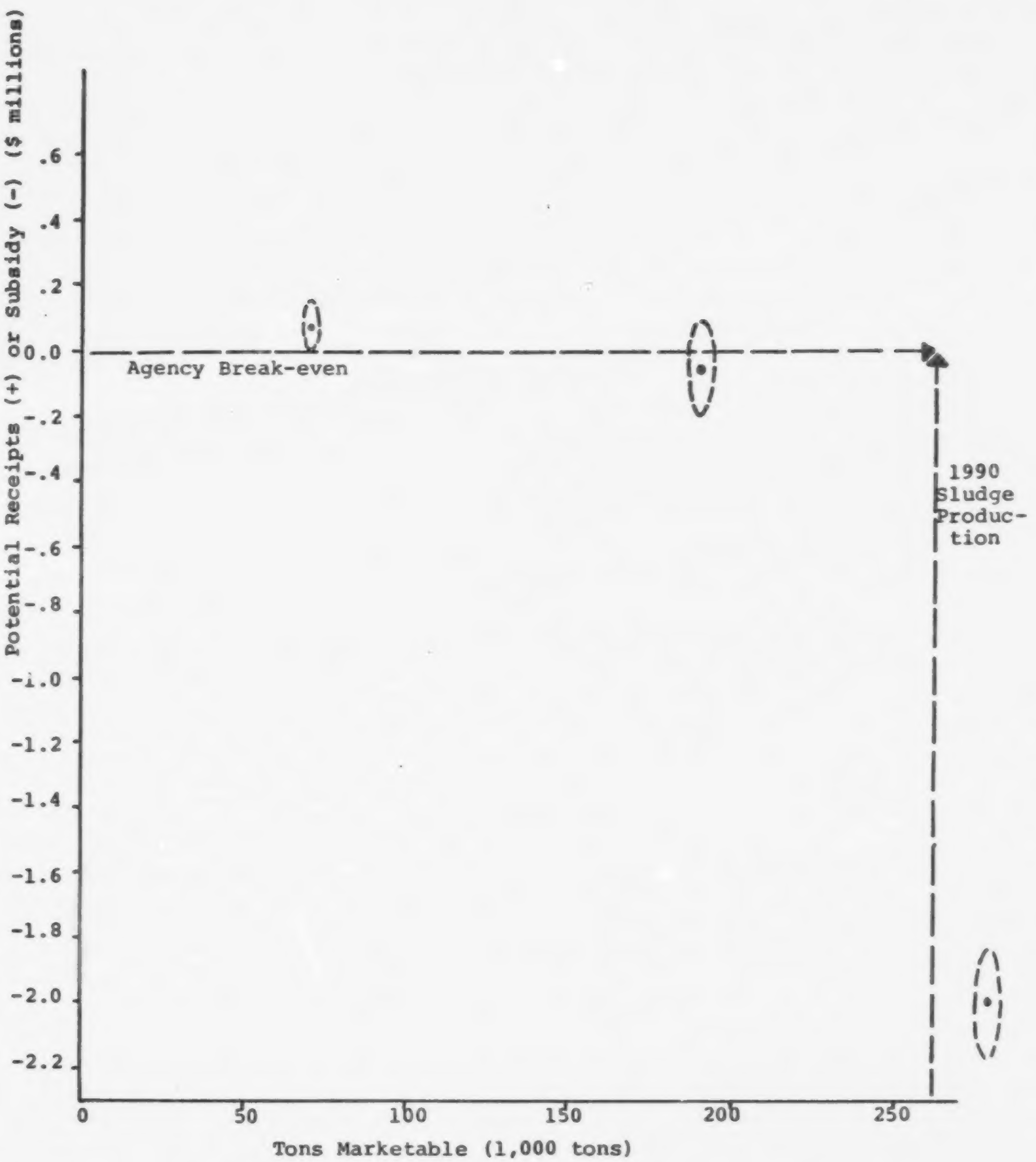
SOME POTENTIAL OVERALL SLUDGE MARKETING STRATEGIES AND THEIR POTENTIAL OUTCOMES IN 1990

	Home and Garden	Specialty	Agricultural	Total
Strategy: Maximize Sales				
Markets to be Served:	Yes	Yes	Yes-Antelope	
Pricing Strategy:	$1/40-lb. bag	$5.50/cu. yd.	$9.40/ton	
Estimated Potential 1990 Demand:	86,900 tons	145,100 tons	50,800 tons	282,800 tons
Potential Demand as a Percentage of Total 1990 Sludge Production:	32%	54%	19%	105%
Estimated Range of Total Annual Producer Receipts:	($1,173,200)-($1,086,300)	($174,100)-0	($828,000)-($726,400)	($2,175,300)-($1,812,700)
Strategy: Maximize Producer Returns				
Markets to be Served:	Yes	Yes	No	
Pricing Strategy:	$2/40-lb. bag	$9/cu. yd.		
Estimated Potential 1990 Demand:	48,800 tons	23,800 tons	0 tons	72,600 tons
Potential Demand as a Percentage of Total 1990 Sludge Production:	18%	9%	0%	27%
Estimated Range of Total Annual Producer Receipts:	$0-97,600	$0-42,800	$0	$0-140,400
Strategy: Mid-range Strategy				
Markets to be Served:	Yes	Yes	No	
Pricing Strategy:	$2/40-lb. bag	$5.50/cu. yd.		
Estimated Potential 1990 Demand:	48,800 tons	145,100 tons	0 tons	193,900 tons
Potential Demand as a Percentage of Total 1990 Sludge Production:	18%	54%	0%	72%
Estimated Range of Total Annual Producer Receipts:	$0-97,600	($174,100)-0	$0	($174,100)-97,600

Source: Gruen Gruen + Associates

FIGURE 6.1

POTENTIAL 1990 OUTCOMES OF SELECTED OVERALL SLUDGE MARKETING STRATEGIES



SOURCE: Gruen Gruen + Associates

ELASTICITY

This makes the elasticity of demand with respect to price a very critical factor in choosing an overall strategy. For example, in the home and garden market demand is inelastic in the range between $2 per bag and $1 per bag, which means that sales increase at a slower rate when the price decreases below $2 per bag. Since volume does not rise as rapidly as revenue falls and some marketing costs (such as bags) remain constant per unit sold, as the price is lowered below $2 per bag, the potential return to the agency producer per ton of sludge declines rapidly from a barely positive range into heavy subsidies. The low elasticity minimizes the benefits of subsidizing the sludge product in order to dispose of more of it. On the other hand, the specialty market demand is very elastic between $9 and $5.50 per cubic yard, so sales rise much more rapidly when the price declines below $9. While some of the costs of serving this market also remain constant per unit sold (such as transportation costs), the other costs decline rapidly on a per unit basis. The result is that, while the potential returns to the producer also decline from a positive range at the $9/cubic foot price to a negative range at the $5.50 price, the required subsidy is estimated at less than $2 per ton. Thus, the benefits of subsidizing sales to the specialty users in order to dramatically increase sales appear much more favorable in this market, though the decision to pursue such a strategy should be made on the basis of the comparative costs of other disposal alternatives.

LOCATION

Location of the production facilities is an important concern with regard to choosing the markets to be served. If production facilities are located at one of the distant processing sites, the cost of transporting the product back into the urban area for sale to the home and garden and specialty markets would add between $18.70 and $26.40 per ton to total costs. This would probably make it more economical to otherwise dispose of the sludge which cannot be marketed in the agricultural market surrounding the processing site. The reverse may also hold as similar costs would be added to total costs in order to transport the product from an urban processing site (either at the treatment plants or a central location) to the identified agricultural markets.

SHIFTING DEMAND CURVES

A factor which should affect the choice of pricing strategies is the potential to shift the demand curve - to actually enlarge the potential market at any given price - by investing in the development of product identification. This is not a strong concern for either the agricultural or specialty markets where the product would be sold in bulk, since users in these markets are concerned with only price and product characteristics. The potential to shift the demand curve with sales and promotional efforts is limited in these markets, which means that a high pricing strategy is risky because it increases the chance that another product with similar characteristics could capture a share of the market by underpricing the LA/OMA sludge product. The diversion of wood by-products to other uses, for instance, is much more likely to affect the specialty market demand curve than any investment in developing product differentiation.

Product identification, however, is a strong concern in the home and garden market where the product would be sold in bags. The appearance of the bag, the brand name of the product, its availability in retail nurseries and discount outlets, retailer recommendations, and the brand name familiarity instilled by advertising all may serve to differentiate the LA/OMA sludge product from other soil amendments and even other sludge-based soil amendments. It is possible to actually shift the demand curve for the specific product by creating product differentiation through a variety of advertising and promotional measures. Such efforts both entail substantial investments and will be undermined if the product is simultaneously being sold to users in this market in large volumes at low prices. Following a high pricing strategy, $2 or perhaps even more per 40-pound bag, in the home and garden market is the only strategy which would enable the marketing firm to generate sufficient revenue to finance such efforts and not simultaneously defeat its own purpose.

CONCLUSIONS

In summary, while the final choice of strategies depends to some extent on the comparative costs of the marketing opportunities and the other sludge disposal alternatives, it is possible to draw some conclusions based on the factors discussed here as to the strategies, particularly with regard to pricing, which would likely have the greatest long-term benefits. The first conclusion is that locating the production facilities in the urban area at the worst precludes serving the agricultural markets, while locating the processing facility at one of the distant sites may preclude serving the home and garden, specialty and non-adjacent agricultural markets. The reason location is so important is that transport costs, estimated by LA/OMA at 22¢ per ton-mile (per Tim Haug, Project Engineer), raise the marketing cost of the sludge product by $18 to $26 per ton if the product must be transported between the study area and either of the distant processing sites.

The second conclusion is that both the elasticity of demand in the various markets and the potential to shift demand curves appear to indicate the most desirable strategy might be to pursue a *relatively high pricing strategy in the home and garden market while adopting the lower price range in the specialty market*. This overall strategy would allow the producer to encourage the heavy investment in developing and differentiating the product most likely to maximize long-term sales in the home and garden market, yet take advantage of the high elasticity of demand and potential shifts in demand caused by other demands for wood by-products to maximize long-term sales and receipts in the specialty market.

IMPLEMENTING A MARKETING PROGRAM

It should be clear by now that there are considerable differences between the markets for a sludge product. No matter which markets are finally served or which pricing strategies are pursued in each, the producing agencies and marketing firm must be careful to maintain a clear separation between the markets. Failure to maintain such separation can easily undermine marketing strategies, leading to producer and/or marketer losses which may cause the failure of the marketing program or at least parts of it. For example, if the product is being marketed in bags to home and garden users through a retail distribution system, but it is possible for homeowners to pick up the same product in small bulk quantities from the facility serving the specialty market, both the retail distribution system and the investment in the packaging and other means of differentiating the product would be undermined.

The types of marketing activities necessary to serve each of the markets have been described previously in this report. The organization or organizations chosen to serve these markets and the contractual relationships established between the producing agency or agencies and the marketing firm or firms must evidence a clear commitment to undertaking those types of full, vigorous marketing efforts and include necessary incentives and other mechanisms to ensure that this commitment is carried out. As mentioned before, this will require establishing a much more involved and better monitored contractual relationship than the standard broker relationships established and maintained by some agencies in other regions in the past. The research conducted for this study makes it quite clear that substantial effort will be necessary to realize the potential sales estimates made in this report. A marketing program must reflect this need if it is to lead to long-term success in marketing a sludge product.

In this report Gruen Gruen + Associates has identified the key characteristics which will determine the long-term success of a marketing program such as the need for incentives to expand the home and garden market and maintain separation of the markets. This report, in combination with other consultants' reports, will provide the LA/OMA project with the information to make the trade-off decisions necessary to identify a long-term sludge management plan. Once these trade-offs are made, Gruen Gruen + Associates will be working with the LA/OMA agencies to develop a marketing program appropriate to the specific marketing strategy chosen.

CHAPTER 7

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APPENDIX A

SURVEY METHODOLOGY

The household survey for this study was administered from January 3 through 7 to 563 randomly chosen households in Los Angeles and Orange Counties. The methodology employed in the field supervision and sampling design are discussed in this appendix and the questionnaire can be found in Appendix B.

INTERVIEWER AND CODER FIELD SUPERVISION METHODOLOGY

Ten experienced interviewers were obtained through a research services firm in Los Angeles and a four-hour training session was held for them on Tuesday, January 3. The interviewers were familiarized with general interviewing techniques and introduced to the purpose of the survey and the questionnaire instrument. A general explanation of the sampling methodology was also given at this time. Next, a detailed explanation of the proper administration and recording procedure was given for each question. A complete interview was then role-played with each interviewer taking part so that any problems in comprehension or delivery could be discovered and corrected. Each interviewer was also requested to complete at least one questionnaire with a respondent who was eligible to answer all the questions on the questionnaire. Respondents who discontinued the interview because no member in the household had responsibility for the care of indoor or outdoor plants were not counted as a complete interview. The completed questionnaires were returned to the field supervisor for her inspection throughout the interview process. As a result of the training process, 3 interviewers were not asked to participate in the survey. During the training session, there were no changes made in the questionnaire, although it was decided that some flexibility would be allowed in delivery of the introduction.

Coding of the completed questionnaires took place from January 16 through 18. The coder training session was held on the first day for six experienced coders. General coding techniques were reviewed and a detailed explanation of the coding instructions for each question was given. Each coder was then given one questionnaire to code and any questions and/or problems were discussed by the group. Throughout the coding period, the coders worked in the Gruen Gruen + Associates office under the supervision of the survey field supervisor.

SAMPLING DESIGN AND METHODOLOGY

The population sampled were households in Los Angeles and Orange Counties which were within the LA/OMA study area. The two counties were sampled in proportion to their share of the population of the study area. Thus, approximately 80% of the sample was comprised of respondents from households in Los Angeles County because Los Angeles County contains approximately 80% of the population of the study area. Table A-1 shows a comparison of the proportionate distribution of the population and the sample between the two counties. Respondents within each county were selected by use of a computerized process called random digit dialing (RDD). This process randomly assigns a quantity of four-digit suffixes for each of the prefixes servicing the sample area. The quantity of telephone numbers generated for each prefix is determined by a probability assigned to each prefix. In this case, equal probabilities were assigned to all prefixes.

Each interviewer was assigned a quota and received a portion of the generated RDD numbers equal to that assigned quota. Not every RDD number generated, however, is subscribed to by a Los Angeles or Orange County resident. Many numbers are ineligible because they are disconnected, changed, a business or pay phone, or not in the sample area. Thus, if any of the original numbers called did not yield a complete interview, the interviewer called an RDD number from a list of substitute RDD numbers until a complete interview was obtained.

A telephone number resulting in no answer or a busy signal would be substituted only after three callbacks were made at varying times of the day and on varying days of the week. In total, 2006 numbers were called and, of those, approximately 25% were original numbers and 75% were substitutes.

A total of 844 calls were made to households who were eligible to complete the questionnaire. This subtotal eliminates all disconnected, changed and business numbers as well as those numbers not in the sample area. Included in the number of eligible households are those numbers called which resulted in no answer after three callbacks. It is important to note that it is unlikely that all of these numbers belong to residences. Table A-2 shows the outcome of these 844 calls. As can be seen, 66.7% resulted in complete interviews and of the remaining 33.3%, 14.6% were refusals, only .5% were incomplete interviews, 10.1% were not interviewed due to a language barrier, illness, etc., and 8.1% weren't answered after 3 callbacks.

The last table (Table A-3) shows the outcome of all random digit dialing calls. Nonserviced numbers claimed 58% of the calls, while 14% of the numbers serviced eligible households, but a complete interview could not be obtained and 28% of the calls resulted in complete interviews.

TABLE A-1
COMPARISON OF POPULATION DISTRIBUTION BY COUNTY OF THOSE SAMPLED AND THE TOTAL POPULATION

County	Population	Sample
Los Angeles	80%	79.2%
Orange	20%	20.8%
	100%	100.0%

SOURCE: Gruen Gruen + Associates

TABLE A-2
OUTCOME OF CALLS MADE TO ELIGIBLE RESPONDENTS

		Number	Percent
Interviewed Households		563	66.7%
Noninterviewed Households			
Refusals	123		14.6
Incomplete Interviews	4		.5
Illness, No English, Other	85		10.1
No Answer After 4 Calls	69		8.1
		844	100.0%

SOURCE: Gruen Gruen + Associates

TABLE A-3
OUTCOME OF THE RANDOM DIGIT DIALING CALL

		Number	Percent
Interviewed Households		563	28%
Noninterviewed Households		281	
Refusals	123		
Incomplete Interviews	4		
Illness, No English, Other	85		
No Answer After 4 Calls	69		
Nonserviced Numbers		1162	58
Disconnected, Nonsubscribed	749		
Business Numbers	311		
Number Changed	76		
Not in Sample Area	26		
		2006	100%

SOURCE: Gruen Gruen + Associates

LA/OMA PROJECT

TASK REPORT #2

POTENTIALLY MARKETABLE SLUDGE PRODUCTS

October 1977

Revised July 1979

GRUEN GRUEN + ASSOCIATES
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CHAPTER 1

INTRODUCTION AND SUMMARY

INTRODUCTION

This report summarizes work undertaken as part of Task 2 of the marketing research element of the LA/OMA Project. The primary purpose of this task was to develop a listing of sludge or sludge-based products whose potential marketability warrants further investigation of the markets in the study area and whose production is compatible with the six sludge management alternatives being considered by the LA/OMA Project team. This report also describes a suggested research design for a market analysis and demand estimation for the products described here as likely to be marketable.

This report is presented in five chapters. Briefly, these include:

1. Summary of conclusions concerning potentially marketable products;
2. Identification and description of the products whose production would be compatible with the six management alternatives;
3. The general types of uses for which these products might be considered on the basis of their beneficial contents and form;
4. The probable marketability of the different sludge products based on a preliminary assessment of the important submarkets for such products; and
5. A suggested research design for a market analysis of the products and submarkets described in Chapter 4.

SUMMARY OF CONCLUSIONS

Table 1.1 lists products our analysis suggests are potentially marketable. Two specific uses are not listed. They are the potential use of liquid sludge as a fertilizer or soil amendment in an operation controlled by a wastewater treatment agency and the potential reuse of pyrolytic or co-pyrolytic char in the pyrolysis or co-pyrolysis process. The feasibility of these specific uses involves engineering and financial concerns which should be resolved before further market analysis is warranted.

TABLE 1.1
POTENTIALLY MARKETABLE PRODUCTS

Most Promising Products and Markets:

1. Sludge compost as a soil amendment for the home and garden market;
2. Sludge compost as a soil amendment for the specialty market;
3. Heat-dried sludge as a fertilizer for the home and garden market;
4. Heat-dried sludge as a fertilizer for the specialty market; and
5. Sludge compost as a fertilizer for area-specific commercial agricultural markets.

Least Promising Products and Markets:

1. Liquid sludge as a fertilizer for commercial agriculture;
2. Heat-dried sludge as a fertilizer for commercial agriculture;
3. Liquid sludge as a fertilizer for the specialty market;
4. Pyrolytic gas and oil; and
5. Sludge for use in manufacturing feed supplements, construction materials and by-products such as oils and waxes, paper and fibre and metals.

Products Requiring Further Study to Assure Technical Feasibility and Obtain Cost Estimates:

1. Steam produced by pyrolysis or co-pyrolysis; and
2. Electricity produced by a steam turbine driven by pyrolytic steam.

One Market Not Yet Investigated:

1. Export of sludge-based fertilizer or soil amendments.

SOURCE: Gruen Gruen + Associates

CHAPTER 2

POTENTIAL SLUDGE PRODUCTS

PRODUCTS

Table 2.1 below shows the distinguishable products which could be produced from the six sludge management alternatives identified as being the most attractive and appropriate for further study in the LA/OMA report of May 1977.

TABLE 2.1
POTENTIAL SLUDGE PRODUCTS

1. Digested Sludge
    a. Nonpasteurized liquid sludge
    b. Pasteurized liquid sludge
    c. Heat-dried sludge
    d. Composted sludge
2. Pyrolysed and Co-pyrolysed Sludge
    a. Pyrolytic gas and oil
    b. Steam
    c. Electricity
    d. Char
3. Feed Supplements, Construction Materials and By-products:
    a. Feed supplements
    b. Construction materials
    c. Oily and waxy by-products
    d. Paper and fibre
    e. Metal recovery

SOURCE: Gruen Gruen + Associates

DIGESTED SLUDGE

NONPASTEURIZED LIQUID SLUDGE

The first product, nonpasteurized liquid sludge, contains beneficial features such as nutrients and organic content, but potential state regulations limit the immediate marketability of this product. It is included as a separate product because of the possibility that this constraint on its marketability may be lifted in the future and because it has a somewhat higher nutrient content than other sludge products.

PASTEURIZED LIQUID SLUDGE

Pasteurized liquid sludge would be usable directly applied to the soil for its nutrient value and soil conditioning properties (organic content). Pasteurization will probably overcome some of the regulatory constraints mentioned above, but the heating of the sludge will reduce its nitrogen content, which reduces its potential value for fertilizer or soil amendment use.

HEAT-DRIED SLUDGE

Heat-dried sludge can take many forms, but generally will be a dry material which can be fortified with nutrients, pelletized as necessary, and bagged or distributed in bulk.

COMPOSTED SLUDGE

Digested sludge can be mechanically composted using either the windrow or static pile processes. In addition, a compost could be produced from raw waste-activated secondary sludge separately from the digested primary sludge. This could result in lower processing costs as digested secondary sludge is more costly to dewater and would result in a compost at the upper range of nutrient value for composts, although it would not result in a product clearly differentiated from others in the market.

No significant product differentiation due to separate processing of primary and secondary sludges would occur. Separate processing could be considered purely on the basis of its engineering and financial desirability because the decision would have minimal impact on the quality of the final sludge product.

Table 2.2 shows the estimated nutrient contents of the sludge products discussed above.

TABLE 2.2
SLUDGE PRODUCT NUTRIENT CONTENTS

	N			P		K	
	lb./dry ton sludge			lb./dry ton		lb./dry ton	
Sludge Product	%	total pounds	available	%	pounds	%	pounds
Nonpasteurized liquid	4.5	90	45	3.0	60	0.4	8
Pasteurized liquid	2.5-3.5	50-70	25-35	3.0	60	0.4	8
Heat-dried	2.5-3.5	50-70	25-35	3.0	60	0.4	8
Composted	1.0-1.5	20-30	10-15	2.5	50	0.2	4

SOURCE: Culp/Wesner/Culp File Data

PYROLYZED AND CO-PYROLYZED SLUDGE

Pyrolysis is a process in which organic material is decomposed at high temperature in an oxygen-deficient environment. The action, causing an irreversible chemical change, produces three types of products: gas, oil and char (solid residue). Water vapor is also produced, usually in relatively large amounts depending on the initial moisture content of the materials being pyrolyzed. Residence time, temperature and pressure in the reactor are controlled to produce various combinations and compositions of the products.

Two general types of pyrolysis processes may be used. The first, true pyrolysis, involves applying all required heat external to the reaction chamber. The other, sometimes called partial combustion and gasification, involves the addition of small amounts of air or oxygen directly into the reactor. The oxygen sustains combustion of a portion of the reactor contents which in turn produces the heat required to dry and pyrolyze the remainder of the contents.

Pyrolysis appears to have several advantages over incineration. For example, some pyrolysis processes can convert wastes to storable, transportable fuels such as fuel gas or oil while incineration only produces heat that must be converted to steam. Pyrolysis gives a 50% greater reduction in volume of residue over incineration and the residue may be a more readily usable by-product. However, it is difficult to reach definitive conclusions regarding pyrolytic products because the application of pyrolysis to solid waste and sludge is still in the developmental stages.

Principal products of several of the more fully developed systems are shown in Table 2.3.

The products from the various pyrolysis systems vary considerably in characteristics. Products of widely varying characteristics can also be produced by varying the operating conditions of a particular pyrolysis system. The actual products will depend on the pyrolysis system, but the following generalizations are typical:

TABLE 2.3
MUNICIPAL SOLID WASTE AND SEWAGE SLUDGE PYROLYSIS PROCESSES

Developer	Products
Monsanto Envirochem Systems, Inc.,St.Louis, MO (Landgard)	Fuel gas or steam, ferrous metal, wet char, glass aggregate
Occidental Research Corp. (formerly Garrett), LaVerne, CA	Pyrolytic oil, char glass, ferrous metal, nonferrous metal, organics in condensate
Union Carbide Cor., NY, NY (Purox)	Fuel gas, slag
Carborundum Env. Systems, Inc., Niagara Falls, NY (Torrax)	Steam (or fuel gas), slag
BSP Division Envirotech, Belmont, CA	Steam (fuel gas)
Nichols Engineering & Research Corp.	Steam
Jet Propulsion Lab, CA Institute of Technology, Pasadena, CA	Activated carbon & fuel gas
DECO/Enterprise Co., Santa Ana, CA	Fuel gas, oil and char
Battelle Pacific Northwest Labs, Richland, WA	Steam (or fuel gas)
Pyrolytic Systems, Inc. Riverside, CA	Fuel gas or electric power
DEVCO Management, Inc. NY, NY	Fuel gas
Pollution Control, Ltd. Copenhagen, Denmark	Fuel gas
Urban Res. & Development Corp. Easy Granby,Conn.	Slag, fuel gas

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SOURCE: Culp/Wesner/Culp

PYROLYTIC GAS

In most cases the pyrolytic gas is a mixture of a number of gases and other products with a heat value of 100 to 500 Btu/ standard cubic foot. The gas typically contains water, oil, tar and other contaminants which are expensive to remove in order to produce a refined gas suitable for general distribution. The gas also leaves the pyrolytic reactor at elevated temporature.

PYROLYTIC OIL

Some pyrolytic processes produce oil. The oil is either used in the reactor or a portion is drawn off with the gas. The Occidental process does maximize oil production and this oil is storable and transportable (1).

STEAM

Steam could be generated at any low or moderate pressure and temperature. The steam purity could also be controlled by appropriate treatment procedures, although the extremely high purity required for use in a public utility's steam turbine electric generator may be unattainable. The steam could be transmitted by pipeline approximately three to five miles with no difficulty and perhaps greater distances if some loss of pressure is not a serious consideration.

ELECTRICITY

Electricity could be generated on-site using the steam generated in pyrolysis and through the further combustion of its gas, oil and char by-products. The electricity generated would probably have to be supplied on a continuous basis with very little peak loading ability.

CARBON OR CHAR

Pyrolytic processes can produce a char of varying characteristics depending on the operation of the pyrolytic reactor. The most important characteristics of the char, in terms of its reuse, are its heat and fixed carbon contents. Both of these are reduced as the operating temperature of the pyrolytic reactor is raised.

FEED SUPPLEMENTS, CONSTRUCTION MATERIALS AND BY-PRODUCTS

FEED SUPPLEMENTS

Several methods, both direct and indirect, have been developed for producing animal feed from sludge. One direct process produces a molasses-type "organic food concentrate" high in protein, carbohydrates, vitamins and salt. By heating activated sludge in the presence of water and small amounts of sulfur dioxide, a filtrate is produced which, when concentrated, produces the molasses-type material. Another direct method for producing an animal feed supplement from sludge is to hydrolize the sludge by acids, alkalis, enzymes or heat to produce a single-cell material. An alternative method to producing animal feed directly from sludge is to use the sludge as a nutrient source for algae, fungi, fish and single-cell protein or possibly worms which, in turn, can be used as animal feed.

CONSTRUCTION MATERIALS

Several proprietary processes have been developed. One proprietary process combines sewage sludge, fly ash and additives to form a material that is biologically inert and free from undesirable leaching characteristics. Another potential use of sludge recently developed by a proprietary process is to mix sludge with glass to form building materials such as tiles and soundproofing boards.

OILY AND WAXY BY-PRODUCTS

Wastewater and sludge contain various fats, oils and waxes commonly called grease and scum which can be recovered. The floating grease and scum can be readily removed from the wastewater at various points within the liquid treatment process, while the rest of the fats, oils and waxes remain essentially emulsified within the wastewater and sludge. This emulsified portion, which forms a petroleum-based oil, can be removed from the sludge as a by-product of the Carver-Greenfield or BEST sludge treatment processes.

PAPER AND FIBRE

Sewage sludge contains fibrous materials which could be potentially reclaimed for use in a low-grade paper product. Although the technology and the market for secondary fibres recovered from solid wastes have been extensively examined, GG+A, in a thorough literature search, has found little information concerning fibrous materials recovered from wastewater solids.

METAL RECOVERY

Sludge contains metals that would be of considerable value if they could be removed from the sludge at a cost that is less than the market value of the metals. The Associated Press reported Dr. I. M. Levitt estimated that the annual wastewater output of Philadelphia contained $7,500,000 worth of gold and

$30,000,000 worth of other valuable metals; however, he went on to estimate that it would cost approximately $100,000,000 to separate these metals from the wastewater and sludge. The problem dramatized by Dr. Levitt's statement is typical of the relationships that we found in our review of the literature on metal recovery potential.

REFERENCES

(1) County of San Diego, On-site Tests Performed on Solid Waste in the San Diego Metropolitan Area

CHAPTER 3

GENERAL USES FOR SLUDGE PRODUCTS

USES

In the previous chapter, sludge products were categorized as digested sludge products and pyrolysed or co-pyrolysed sludge products, and the beneficial aspects of each were briefly described. This section relates those beneficial aspects to general uses and describes the suitability of the sludge products for these general uses. The following section will describe these uses in more detail, identify competing products and discuss prices and volume potentially obtainable in each market.

DIGESTED SLUDGE PRODUCT USES

The uses for digested sludge products generally break down into three groups: (1) commercial agriculture; (2) nursery and other specialty; and (3) home and garden. Digested sludge or digested sludge-based products could be considered for either fertilizers or soil amendments.

Fertilizers are primarily valued for the one or more nutrients they contain which have high value in promoting plant growth: nitrogen (N), phosphorus (P) or potassium (K). This is true whether they are organically or inorganically based. Nitrogen is the most important, complex and variable of these nutrients in that only part of the nitrogen content of a fertilizer is immediately available and release rates vary. Sludge contains a slow-release nitrogen.

However, all digested sludges may encounter difficulties being classified as fertilizers because many do not contain the minimum levels of nutrients specified by state laws. The nutrients they do contain frequently are not uniformly distributed throughout the substance so that they may not meet the strict state standards concerning the uniformity of nutrient content. Since the nutrient content of sludges may also vary over time and from one treatment plant to another, it could become necessary to fortify some sludges with additional nutrients to meet content uniformity standards for large volumes of a given fertilizer product over time. This obstacle can clearly be overcome by further processing the sludge product to assure its uniformity, but this would substantially increase production costs.

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Soil amendments may contain some of the important nutrients, but generally low concentrations (particularly nitrogen). They are not subject to the strict uniformity standards applicable to fertilizers. They are usually valued for their pH neutralizing effect, beneficial metals content (such as zinc) or the organic matter they may add to the soil. Sludge contains traces of numerous beneficial metals and organic matter and may affect the pH balance of soils, depending on how the sludge is processed.

Sludge products contain traces of heavy metals, the amount varying by the type and amount of industrial discharge into the sewer systems within the sanitary district. As mentioned above, some of these metals are beneficial to plant growth in limited concentrations. Some become quite toxic, even at low concentrations, if they become part of the food chain; cadmium is frequently cited as the most dangerous. These heavy metals pose a very significant problem in that they accumulate in the soil, creating a long-term hazard as well as the potential one-time application hazard. This risk also varies considerably with soil type and from one crop to another; some plants, leafy vegetables for example, tend to absorb more of the heavy metals from the soil than do others. Because the nutrient content of most sludge products is low as a percentage of weight and bulk, many users would require heavy applications of sludge products to obtain desirable nutrient levels, requiring careful consideration of the risk associated with these heavy metals.

LIQUID SLUDGE

Liquid sludge could be considered either as a low-grade fertilizer or as a soil amendment. In either case, it would be valued for its small, slow-release nitrogen content, moderate phosphorus content and organic matter content. Use could be considered either as part of an agency-controlled project, which would probably be aimed at reclaiming marginal land for agricultural use, or for sale to commercial agricultural users. Specialty or home and garden uses would likely not be feasible as the difficulty of transporting and/or packaging a liquid would make anything but a quite large application economically prohibitive. Use as part of an agency-controlled project will not be considered further here as it is considered more of an engineering and financial concern than a marketing question.

Nonpasteurized sludge has a somewhat higher nitrogen content than the pasteurized liquid because it has not been heated as much, but may not be usable or preferable because of the risk that it might contain pathogens.

HEAT-DRIED SLUDGE

Heat-dried sludge would probably be pelletized as it comes out of the dryer for use as a low-grade fertilizer or fortified with additional nutrients, particularly nitrogen, pelletized and used as medium grade fertilizer. Either of these fertilizers could be distributed in bulk or bagged and readily used by commercial agricultural, specialty or home and garden users. Its primary value in this form would be its slow-release nitrogen and its organic base.

COMPOSTED SLUDGE

Composted sludge would be used as a soil amendment. Although it does contain a very small amount of nitrogen, it would be valued for its phosphorus and organic content. A compost could be distributed in bulk or bagged and used in commercial agriculture, specialty or home and garden uses.

PYROLYTIC AND CO-PYROLYTIC PRODUCT USES

Pyrolytic and co-pyrolytic products could primarily be used as energy sources or as substitutes for other energy sources in the production of steam for various uses. The exception to this generalization is char, which could have a variety of nonenergy uses, but it seems unlikely that production of char would be the primary purpose of pyrolysis or co-pyrolysis; therefore, it should be considered as a by-product.

PYROLYTIC GAS

As mentioned previously, pyrolytic gas is generally a mixture of gases and other products with a heat value of 100 to 500 Btu/standard cubic foot. The Purox process does maximize gas production and reportedly produces a refined gas suitable for general use; however, the cost and regulatory problems associated with off-site transport may be formidable to the extent that the sale and delivery of the small quantities of gas likely to be produced may not be economical(1). The gas could be used on-site in an afterburner or special boiler to generate steam, the use of which will be described later.

PYROLYTIC OIL

Oil produced by pyrolysis or co-pyrolysis is corrosive, but storable and transportable. It can be used in utility boilers when blended with No. 6 fuel oil. It may have other characteristics that would limit its use or at least dictate modifications to boilers in which it would be used. It can also be used in the reactor to maintain the co-pyrolysis process.

STEAM

The low-to-moderate pressure and purity steam (after processing to remove impurities) which would be generated could be considered for: (1) on-site use as steam; or (2) off-site use as steam. The uses for electricity generated on-site will be discussed below. The on-site use of steam would be limited as it is assumed that both the sludge digesters and the pyrolysis or co-pyrolysis process would be energy self-sufficient in most cases; therefore, on-site use of steam would most likely be to generate electricity for use as discussed below. Since steam could be transmitted by pipeline three to five miles and more if some pressure loss can be tolerated, it could be used for a variety of off-site uses within reasonable distances of the producing location. The steam would have value primarily for industrial users who now generate steam using utility boilers which generally burn fuel oil.

ELECTRICITY

The possibility of off-site generation of electricity will not be considered because of the difficulty of producing and transporting steam with the high pressure, temperature and purity required for use in a public utility's steam turbine.

Electricity could be produced on-site using steam at moderate temperature and pressure to drive a turbine generator. Some, but not all, of this electricity could be used on-site to power pumps, lighting and so on, but there would be a fairly continuous supply of excess electrical energy which could be sold to other users or a public utility. This source of power would be of value to an operation that is essentially continuous with little peaking in energy demand such as some industrial operations or a utility's base-load power requirements.

CHAR

Char has several potential uses, although more study will be necessary before its value in any of them can be effectively estimated. The following uses could be considered: (1) low-density aggregate; (2) activated carbon; or (3) pyrolytic or co-pyrolytic reactor fuel; or (4) other fuel uses. Char could be used as a low-density aggregate in products such as lightweight concretes; however, this use would not take advantage of its heat value.

Activated carbons are used in a wide variety of applications to assist in filtering organic matter out of liquid. Use in wastewater treatment has been demonstrated in the JPL process in Orange County. Char powder was mixed with primary effluent at a one million gallon per day pilot plant, settled out with the sludge, dewatered, pyrolyzed and recycled through the process again.

While the heat value of char is relatively low, it could be used as an industrial fuel comparable to low-grade coal or possibly in other fuel uses such as charcoal, if processed into bricquets, for example.

Finally, the heat value of char could be used within the reactor to maximize steam production, although pyrolysis at the elevated temperatures necessary to utilize the char may cause some heavy metals to vaporize, creating an air pollution problem. Metals of particular concern would be cadmium, lead and mercury, all of which exhibit considerable vaporization at temperatures of 1,500 degrees Fahrenheit.

Pyrolysis at temperatures above 1,800 degrees Fahrenheit would also melt glass and metal in unprocessed solid waste in a joint operation to produce a slag (Purox process). This slag might be suitable as a construction fill material.

The most appropriate use at this time would appear to be as reactor fuel due to its unknown value for other uses. Problems associated with this use are engineering and environmental, not marketing; thus, no further consideration of this use will be made.

FEED SUPPLEMENTS, CONSTRUCTION MATERIALS AND BY-PRODUCTS

FEED SUPPLEMENTS

The use of sewage sludge and animal manure as an animal feed or feed supplement has been extensively examined during the last two decades. Research conducted by the Department of Animal Nutrition at the University of Illinois has found that the biological value of heat-dried, activated sludge is comparable to that of many cereals used as additives to animal feed for pigs, poultry and ruminants. Activated sludge contains sources of Vitamin B-12, amino acids, nitrogen, fats, calcium, phosphorus, crude fibre, and other organic and inorganic matter found in animal feed. The University's research has further shown that the use of activated sewage sludge as an animal feed for pigs or chicks produced no pathological systems in the animals' tissues. Sludge has also been proposed as a feed for worms and experimentation is underway to determine the effects of various characteristics of sludge such as heavy metals content on worms.

CONSTRUCTION MATERIALS

One such material, called POZ-0-SOIL, produces a soil-like material used in road embankments and as a landfill material. Sludge materials substitutable for accoustical tiles and sound-proofing boards have also been developed.

OILY AND WAXY BY-PRODUCTS

The various oils, fats and waxes which can be recovered from sludge can be used for their heat value. It is also believed that the fats, oils and waxes found in wastewater and sludge could possibly be recovered and used in manufacturing soaps. To date, we have found no evidence that the technological potential for the manufacture of soaps from sludge by-products exists.

PAPER AND FIBRE

At least some of the different grades of fibrous material which could be recovered from sludge could be used as pulp subsititutes in the production of paper products.

METAL RECOVERY

Metals which are recovered from sludge could be sold for reuse in the customary markets for each metal.

REFERENCES

(1) Culp/Wesner/Culp, File Data.

CHAPTER 4

MARKETABILITY OF SLUDGE PRODUCTS

MARKETABILITY

The previous two chapters have discussed the products which could be made of sludge and the general types of uses for these products. This chapter describes the markets within which the sludge products would have to compete and analyzes the likelihood that the sludge products could be sold by comparing their advantages with those of the products with which they would have to compete, the cost effectiveness of the sludge products, the reliability of the market, compatibility with sound wastewater treatment technology and potential environmental or health impacts. Conclusions are then drawn as to which products appear likely to be marketable within specific submarkets. The following chapter then suggests a research design for an analysis of the market for these potentially marketable products.

FERTILIZERS FOR COMMERCIAL AGRICULTURAL USE

Liquid sludge has such a low content of the critical nutrient nitrogen that extremely large volumes of it must be applied in comparison to commercial fertilizers in order to obtain the desired nitrogen application rate. Farmers could not apply it by any of the methods currently used to apply commercial fertilizers. For this reason, the price of a liquid sludge product would most likely have to include delivery and application. Existing fertilizer dealers do not have equipment or training to provide this service. Some investment in assuring such capabilities or establishing an entirely separate distribution system would have to be made.

Because of its high water content, transportation costs would also be very high per unit of nutrient. There may be specific sites which could benefit from the nutrient and organic content of liquid sludge, particularly where the site is located in relatively close proximity to a wastewater treatment plant. However, it is unlikely that a significant number of users would be willing to pay enough for liquid sludge to cover the transportation and spreading costs. The heavy metal content would also be a major roadblock in any program to market sludge for application on any food-chain crop. Liquid sludge could be used in a wastewater treatment agency-controlled operation for the purpose of reclaiming agricultural land; however, we do not consider this a marketing problem.

Heat-dried sludge has a similarly low nutrient content, but because of its usually pelletized form, it can easily be spread by farmers and distributed to them by wholesale fertilizer dealers. It can be fortified with chemical fertilizers to increase its nutrient content. While this would allow the final product to compete more effectively with the numerous medium grade fertilizers on the market, the wholesaler would still purchase the sludge on the basis of its original nutrient content, less distribution and marketing costs. Based on the price of other fertilizers sold in this market, the value of heat-dried sludge delivered to the wholesaler would probably fall in the $3.00 to $5.00 per ton range, tending toward the lower figure as volume increases. While volume could be fairly high, marketing a heat-dried product in this market may not be cost-effective due to the high costs of the energy-intensive heat-drying process, the low value of the resulting product and would be limited by its heavy metal content.

SOIL AMENDMENTS FOR COMMERCIAL AGRICULTURAL USE

A sludge compost would generally compete with poultry and steer manure, all of which are valued primarily for their phosphorus and incidental nitrogen contents and, secondarily, for their organic and beneficial metals contents. Table 4.1 shows the general nature of southern California soils and their requirements as far as this type of amendment is concerned.

TABLE 4.1
SOUTHERN CALIFORNIA SOIL TYPES AND REQUIREMENTS

County or Area	Soil Types	Requirements
Eastern Riverside	Sand	Phosphorus, organics
Western Riverside	Sandy loam	Some phosphorus
Kern	Loamy sand	Some phosphorus, zinc, organics
Ventura	Sand to clay	Little phosphorus or organics
Imperial	Heavy clay to clay loam	Phosphorus but no salts
San Bernardino	Sandy loams	Some phosphorus
Orange	Sand to loam	Little phosphorus
Los Angeles	Sand to loamy sand	Phosphorus, organics

SOURCE: Agricultural Extension Advisors

In terms of the volume of demand and need for phosphorus, eastern Riverside County is a significant market. There is currently a large trade in poultry manure in this area. Kern County also has a significant market currently served by local poultry and cattle ranchers. Ventura and Los Angeles Counties both import small to moderate volumes of manure from San Bernardino County, where less than one-quarter of the local poultry manure production is used by local farmers. Imperial County needs the nitrogen and phosphorus which can be supplied by such soil amendments and significant volumes of steer manure are used, but some soils cannot tolerate the salt content of either manures or sludge compost. This salt problem is not currently significant elsewhere; however, all southern California soils tend to be alkaline, so that growers will be concerned with the salt content of a sludge compost in relation to that of manures. Of course, growers will also be concerned about the heavy metals content of a sludge compost.

In eastern Riverside and Kern Counties, there are both sizable producers and consumers of manures. Many of the producers transport and spread the manure as part of the sales arrangement since few farmers own the equipment necessary to transport or spread large volumes of manures. The transport cost is critical in this bype of operation. Delivery to locations more than about 50 miles distant reduces the net value of the manure itself to zero as the range of prices the growers will pay is very limited.

The only areas where it currently appears that a significant amount of manure may be being sold at net value greater than zero are eastern Riverside and possibly Kern Counties. Poultry manure in eastern Riverside is selling for about $10 per ton, delivered and spread. While manures are being trucked significant distances into Los Angeles and Ventura Counties, the only reason is that most of it is being obtained free or nearly so in San Bernardino County where there is a considerable excess.

Among the manures, poultry manure is the most desirable because of its high nitrogen and phosphorus contents, which average about 3.2% and 1.7%, respectively. While a sludge compost could offer more phosphorus (2.5%), it would contain less nitrogen (1.0-1.5%). While this market would probably absorb a significant volume of sludge compost as a soil amendment, it seems likely that the market may not be a cost-effective one between the costs of producing, marketing and especially transporting and spreading it, except in the case of area-specific markets in which a sludge drying and composting facility might be located as proposed in the LA/OMA Project's long-distance transport alternative.

FERTILIZERS AND SOIL AMENDMENTS FOR THE SPECIALTY MARKET

The general field of landscaping, within which we include landscaping for new homes, commercial nursery and turf production, and golf course, cemetery, park and general public landscape construction and maintenance, also represents a significant potential market for sludge-based fertilizers and soil amendments.

Liquid fertilizers are not as commonly used in this market as in commercial agriculture so that liquid sludge would face a low demand situation in addition to its handicaps of handling difficulty and high transport cost per unit of nutrient. Interviews with a small sample of golf course greenskeepers indicated that a pelletized heat-dried sludge sold in the specialty market for use as a fertilizer or base for a fortified fertilizer would be in significant demand if priced about the same proportionate to its nutrient contents as chemical fertilizers. Because of its high production costs, the cost effectiveness of marketing a heat-dried sludge to fertilizer producers remains somewhat questionable.

A significant volume of soil amendments are consumed by specialty users. The most commonly used amendments are fir bark, sawdust and peat moss, all of which are used for their organic content, sometimes mixed with sand, for uses such as potting and bedding soil in nurseries and topdressing for golf courses. A sludge compost would offer organic content and some nutrients for these uses and could probably compete quite effectively in this market if a strong marketing program aimed at landscape contractors and wholesale nurseries were undertaken.

The position of a sludge compost in the specialty market could become even stronger in the future as the wood products with which it would compete, which are by-products of lumber production, could be demanded for their energy content as the price of coal and oil increase. While the probability that this will occur is uncertain, it indicates the importance of further studying this market as such a change could strongly influence the price and/or volume of sales of a sludge compost.

FERTILIZERS AND SOIL AMENDMENTS FOR THE HOME AND GARDEN MARKET

The home and garden market for a soil amendment product such as a sludge compost appears to be the most promising market in terms of cost-effectiveness, reliability, compatibility with existing technology and potential environmental and health impacts. This is clearly borne out by the success of Kellogg in marketing composted sludge alone and in combination with other materials such as wood and peat in the southern California market. This marketing program has existed for over 30 years.

Although its focus was originally local agriculture, the specialty and home and garden markets were brought into play over 25 years ago and today account for a very large percentage of sales. Currently, the volume processed and distributed is approximately 36,000 tons annually, but demand is reportedly outstripping supply by at least 15% (2).

Our knowledge of the market for a sludge compost in the northern California home and garden market indicates that it is a substantial sized market and is not as price sensitive as either the specialty or agricultural markets. Of course, the potential impacts of the heavy metal content of sludge would have to be considered before a new or substantially larger volume of sludge compost could be offered. While knowledge of the southern California home and garden market does not exist to a similar depth as that for northern California, all signs seem to indicate further work along this line in order to quantify demand and price relationships and develop marketing strategies would be warranted.

FERTILIZERS AND SOIL AMENDMENTS FOR EXPORT

Export of sludge or a sludge-based product is currently being investigated by LA/OMA Project staff separately from the marketing study.

PYROLYTIC GAS AND OIL FOR INDUSTRIAL USE

Presently the marketability of these products cannot be reliably estimated because the contaminants that both contain pose problems in substituting them for natural gas or fuel oil in industrial boilers. More research into the costs of removing these contaminants or modifying industrial boilers may be warranted to establish the cost-effectiveness and technical feasibility of this use, although both of these products can be reused in the pyrolysis or co-pyrolysis to maximize the output of other products. The costs and benefits of this latter alternative are not a marketing question.

STEAM FOR INDUSTRIAL USE

The cost-effectiveness of generating and distributing steam to industrial users via a pipeline system would vary significantly with the location of the steam generator and cost of processing the steam to remove impurities. More research into the feasibility and costs of generating, processing and distributing pyrolytic steam in addition to research into the prices and volumes potential users would accept is needed to establish the cost-effectiveness, size and reliability of this market. It would probably be most appropriate to concentrate research on the feasibility and costs of producing steam at this time.

ELECTRICITY FOR INDUSTRIAL OR UTILITY USE

Electricity generated on the wastewater treatment site could be sold to industries or to a public utility such as Southern California Edison. Direct sale of electricity to more than one user is not recommended because this could place the seller in the role of a regulated public utility. The sale of all available power to a single industrial user would probably not be cost-effective as it would be difficult to match power requirements with generation capacity accurately over time so that back-up utility connections would be required.

It was determined in an earlier study (3) that Southern California Edison is prepared to provide compensation to a producer of electricity depending on the volume and reliability of the supply, but not to exceed the cost of generation of a similar volume of electricity by existing or planned Edison facilities which could otherwise be utilized. Research into the technical feasibility and cost of producing electricity appears most appropriate prior to undertaking further analysis of this market.

FEED SUPPLEMENTS

The use of sludge as an animal feed is attractive because the demand for the product is not seasonally dependent as are other proposed uses for sludge, such as fertilizers. Furthermore, with increasing costs of alternative conventional sources of animal feed, the higher priced sludge-based animal feed becomes an increasingly attractive substitute product to the consumer.

On the other hand, other technological, legal and marketing factors serve to negate these attractive features. Much research is yet to be done to estimate the quality and quantity of sludge which safely can be fed to most animals and the effect of the sludge on the food chain. Of concern is the possible transmission of pathogens, heavy metals and undesirable organic residues present in sludge which could be potentially transmitted into food products. Some feeding studies indicate that an "organic food concentrate" made from sludge is safe at a 5% level in the diets of the animals studied. The federal and state regulations on use of sludge in animal feed are currently unclear and have served to deter further research in the area and, when made clear, are likely to be stringent for using sludge in feed to animals for human consumption. This would be true of any use of sludge as a worm feed if the worms or their castings may, in any way, enter the food chain.

Finally, the use of animal manure as a feed supplement would likely capture most of the market that could have been potentially served by sludge-based feed supplements. Animal manure is produced in the same area in which it would be most likely distributed as a feed supplement and is readily available at essentially no cost, except for transportation, to the consumer. It has been estimated that, in less than 10 years' time, machines which prepare animal manure as a feed supplement will be in common usage on most farms. Thus, it is doubtful that wastewater sludge prepared as an animal feed would be competitive either with conventional animal feed or feed prepared from animal manure.

CONSTRUCTION MATERIALS

The use of sludge and sludge ash in the manufacture of construction materials has been demonstrated only on a limited or experimental basis. It is doubtful whether a market exists at this time for such construction materials. There may, however, be some long-range market potential once the technology in this area becomes better developed.

OILY AND WAXY BY-PRODUCTS

There is little or no market value for the grease and scum collected from wastewater. It is common practice to anaerobically digest the skimmings to recover the heat value as digester gas or to be used by a renderer. If the plant does not contain anaerobic digesters, the skimmings are disposed of in the least costly manner.

Generally, sludge contains about 12% by weight of petroleum-based oil, with a heat value of 16,000 Btu/pound of oil. About 80% can be removed and this will provide a heat value of about 1,535 Btu/pound of dry sludge solids. The petroleum oil extracted from sludge has a probable maximum fuel value of $6.70 per ton of dry sludge solids, assuming a value of $2.16 per million Btu. The value could be considerably lower depending on the value of the heat.

PAPER AND FIBRE

While we can gain some insight into the nature of the fibre recovery industry by examining information concerned with solid waste recovery, we cannot, on a preliminary basis, come to a conclusion about the feasibility of a market for paper and fibre by-products from sludge.

The paper stock industry is the principal vehicle for the recycling of secondary paper wastes. The wastes are funneled through the collecting, sorting, grading, packing and shipping processes which come within the overall organization of the paper stock industry. The different grades of material are then subjected to a fibre-recovery process. It is technologically feasible to recover at least 75% of the fibre fraction in the waste stream, either in the form of a mixed paper waste or as a fibre pulp. Currently, 25% of the fibre produced each year enters the secondary fibre market. The other 50% of the fibre produced enters and leaves the secondary fibre market principally in response to fluctuations in price levels. The market for secondary fibre is highly cyclical and tenuous at best.

METAL RECOVERY

Metal recovery from sludge does not seem likely to be economically feasible except where unusual concentrations of valuable metals may be found in the wastewater stream. Feasibility in this case is primarily an engineering consideration, not a marketing problem as the value of metals may readily be ascertained through dealers.

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CHAPTER 5

RECOMMENDATIONS FOR FURTHER STUDY

It is the conclusion of this task report that soils amendments (sludge composts) and fertilizers (heat-dried sludge) for the home and garden and specialty markets are the combinations of products and markets that most warrant detailed market investigation in Task 3 under this contract. While the cost effectiveness of marketing soil amendments (sludge compost) to certain area-specific commercial agricultural markets is not at all certain, it is nevertheless recommended that the Kern County and eastern Riverside County (Coachella Valley) markets be studied further in Task 3 in order to quantify potential demand in these areas. It has also been brought to the attention of the consultant that similar soil conditions may exist in the Antelope Valley. While there is currently little agricultural production in the Antelope Valley due to the lack of water, new water rights have been obtained recently so that study of the potential agricultural demand for soil amendments in this area in Task 3 may also be warranted. Pyrolytic products (steam or electricity) may also warrant detailed market investigation under future task orders if reasonable assurance of the technical feasibility is available and other studies currently being conducted by LA/OMA with respect to solid waste indicate the desirability of exploring this alternative. Development of the more exotic products such as feed supplements should continue to be monitored, but it is not recommended that the marketability of such products be further investigated at this time.

TASK 3 OBJECTIVES

The two principal objectives of this task should be to: 1) estimate the demand for the alternative sludge products and markets identified above as being the most promising potentially marketable products; and 2) develop alternative marketing strategies and estimate the volume of each product which could be marketed.

Estimates of the demand and marketing strategies applicable to the pyrolytic products described are not identified as objectives of Task 3 at this time because of the related current efforts being conducted by LA/OMA. Although specific tasks necessary to estimate the demand for these products are described below, it is not proposed that these tasks be carried out at this time. If the efforts being pursued by LA/OMA are completed and the need for carrying out these tasks remains, an addendum to Task 3 could be drafted to include these tasks.

TASK 3 WORK ELEMENTS

1. Conduct a survey of household consumers to serve as input to the analysis of demand for soil amendments and fertilizers for home use. The survey will concentrate on consumer attitudes to direct purchase of sludge compost and heat-dried sludge-based fertilizers.

2. Survey a representative sample of the various groups of potential specialty users of sludge-based soil amendments and fertilizers. This would include golf course and cemetery operators and public agencies which utilize composting materials and fertilizers. This survey will concentrate on discerning the factors that encourage or discourage use among these consumers (price, quality, form, etc.).

3. Interview agricultural agents, farmers and other appropriate experts in the Coachella Valley, Antelope Valley and Kern County in order to identify the characteristics of the apparently unusually high demand for soil amendments in these specific areas.

4. Estimate the delivered market value of each product in each market.

5. Obtain economic and demographic data on population and land use trends in the Los Angeles-Orange metropolitan area for use in forecasting the volume of sales obtainable in each market.

6. Describe the alternative types of distribution systems which could be used in order to market the product.

7. Forecast the demand for the marketing strategies (consisting of products, markets and distribution systems) identified as being most promising based on the survey data.

8. Summarize the results of the above task elements in a report describing the most promising marketing strategies and the related sales revenue and volume forecasts.

ADDITIONAL WORK ELEMENTS DEALING WITH PYROLYTIC PRODUCTS

9. Survey potential industrial users of steam in the Los Angeles-Orange metropolitan area to identify potential ranges of demand for steam by location and any quality requirements (temperature, pressure, purity, etc.). The survey would also ascertain willingness-to-pay based on current expenditures for alternative sources of steam.

10. Review public utility rate schedules and rulings and interview appropriate officials in order to identify the value of electricity which could be generated through use of pyrolytic steam.

11. Estimate the potential distribution costs and revenues from sales of steam or electricity on a site-specific basis in order to assess the potential feasibility of marketing pyrolytic products. Summarize the results of these investigations in an addendum to the report described in task element 8.

CHAPTER 6

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SECTION III

EXISTING AND PAST SLUDGE PRODUCT MARKETING EXPERIENCES

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ASSESSMENT OF EXISTING AND PAST SLUDGE PRODUCT MARKETING EXPERIENCES

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PREFACE

National concern for environmental protection and resource recovery has resulted in a wide range of legislation which affects wastewater treatment and the disposition of residuals. In the program to develop a long-term sludge management plan for the Los Angeles - Orange County Metropolitan Area, LA/OMA Project is performing several innovative studies and demonstration projects. Among these is this assessment of the market potentials for wastewater solids.

This report consists of Task Report #1 prepared by marketing consultants, Gruen Gruen & Associates and Culp/Wesner/Culp. It is an assessment of existing and past sludge product marketing experiences. The current practices of two of the participating agencies, the County Sanitation Districts of Orange County and the Los Angeles County Sanitation Districts, are described. Additional current practices are identified for communities outside the study area. The report also includes a discussion of the past reuse efforts in Southern California.

This report will be supplemented with further studies that will include specific marketing strategies for the participating agencies.

INTRODUCTION

Sludge management in the Los Angeles - Orange County Metropolitan Area is principally the responsibility of the three major wastewater treatment agencies operating in the area --

- City of Los Angeles
- Los Angeles County Sanitation Districts
- County Sanitation Districts of Orange County

In 1976, these agencies collectively received about 900 dry tons per day of sludge for processing and disposal. By the year 2000, the volume of sludge is expected to double, principally as a result of the implementation of secondary treatment. The major portion of this increase (about 80%) is expected to occur by the late 1980's. Additional factors which magnify the resulting problem of sludge management are the need to comply with State and Federal prohibitions of sludge discharge to the ocean and uncertainty associated with the substantially different character of the sludge that will be produced by secondary treatment.

LA/OMA PROJECT BACKGROUND

The need for a regional approach to the sludge management problem was recognized in 1973 with the initiation of discussions among the local agencies and the State and Federal governments. In October, 1974, a Joint Powers Agreement was executed which created the LA/OMA Project and established a five-member Policy Board to guide and direct the Project.

Current Policy Board members are:

Richard Coddington	Environmental Protection Agency
Fred A. Harper	County Sanitation Districts of Orange County
Walter E. Garrison	Los Angeles County Sanitation Districts
Donald C. Tillman	City of Los Angeles
Larry F. Walker	State Water Resources Control Board

The Joint Powers Agreement provided that a Project Manager be retained and provided with overall responsibility for conduct of work. The Project employs a total of ten persons. In addition to the Project Manager, three persons are engineers, two are assigned to public participation, one person is an environmental scientist, and the remainder are support personnel.

Work Program

The goal of the Project is to develop a long-term sludge management plan and implementation strategy. The plan is to provide for reuse and disposal of the residual solids resulting from municipal and industrial wastewater treatment in an environmentally, economically, and socially acceptable manner.

The Phase I Report published by the Project in August, 1976, describes the Project work program and defines 17 systems for processing and disposition of sludge. These 17 systems represent the candidate alternatives which were considered to be deserving of examination prior to formulation of the sludge management alternatives which would receive detailed evaluation.

The work program consists of the following four basic components:

- Demonstration projects to develop operational experience and design information. These demonstration projects are being conducted by the local participating agencies with funding from LA/OMA Project.
- Formulation of sludge management alternatives through screening of candidate systems by evaluation of the technical, economic, environmental and social factors associated with each candidate system.
- An active, ongoing public participation program to seek and develop public awareness, comment, and recommendations.
- A planning process to consolidate results from the other program components and provide for: evaluation of sludge management alternatives, formulation of a sludge management plan and implementation strategy, and preparation of the environmental impact statement and project report.

The LA/OMA Project has been underway on a full scale basis since the first part of 1975. During the first year of full time effort, work centered around the recruitment of staff, project organization, identification of candidate systems, preparation of a State of the Art Survey Report on sludge processing and disposal, formulation of the Project work plan, and publication of the Phase I Report. The Project has now moved into active development of the sludge management plan and conduct of studies.

ASSESSMENT OF EXISTING AND PAST SLUDGE PRODUCT MARKETING EXPERIENCES

The concept of recycling sludge is not new. However, developing sludge product marketing strategies for sanitation agencies is very pertinent to LA/OMA's planning efforts.

This report describes the current and past marketing operations in Southern California as well as other major communities. Among the major findings are:

- The revenues earned by the wastewater treatment agency will not cover the full cost of processing and marketing sludge-based products.
- The quality and form of the product that can be successfully marketed must meet the requirements unique to the particular market that absorbs it.
- Sludge user groups can be categorized into three types of markets: agricultural users, professional or specialty markets, and the home and garden market.

The following sections were prepared by Gruen Gruen + Associates and Culp/Wesner/Culp. This report will be utilized in the development of a sludge management plan for the Los Angeles/Orange County Metropolitan Area.

SECTION I

ASSESSMENT OF EXISTING AND PAST SLUDGE PRODUCT MARKETING EXPERIENCES

Sludge-based products have been marketed in southern California and elsewhere for more than 50 years. But only a small percentage of the sludge marketing efforts that have been attempted by United States wastewater treatment agencies and their contractors over the last 50 years are still in operation today. Many attempts to market sludge as one aspect of disposal programs have failed and been discontinued, while others have been totally revamped in efforts to overcome high costs or other disadvantages of disposing of sludge in the market place. Currently operating as well as past attempts to market sludge have produced a variety of products and utilized many different types of marketing approaches. The purpose of the research reported on in this task report was to review existing and past sludge reuse operations in order to identify significant marketing factors that led to their success or failure.

Section II of this report presents the findings we have made and conclusions we have drawn from our review of existing and past sludge reuse operations.

Section III of this report briefly describes the two existing southern California sludge marketing operations that we reviewed. One of these is the large-scale sludge composting operation of the Los Angeles County Sanitation Districts (LACSD). Their material is marketed by the Kellogg Supply Company, an organization with extensive experience in the distribution of sludge-based soil amendments and fertilizers. The other operation markets digested sewage sludge from County Sanitation District #1 of Orange County. The Golden West Fertilizer Company is the contractor that both processes and markets this sludge.

Section IV of this report describes the discontinued production and marketing of a sludge-based soil amender produced by the City of Los Angeles between 1950 and 1960.

Section V of this report cites examples of sludge marketing operations in areas outside of southern California. This section categorizes the experiences of various agencies in terms of the type of sludge product that was or is currently being produced.

SECTION II

FINDINGS AND CONCLUSIONS

Listed and discussed below are the key marketing concepts and relationships that our review of existing and past reuse operations suggests are critical to the success or failure of attempts to market sludge products.

A. PRODUCT COST AND REVENUE RELATIONSHIPS

All successful sludge marketing operations have recognized that the revenues that can be earned by the wastewater treatment agency are not going to cover the full cost of processing and marketing the sludge-based product. Successful operations - those that have continued to exist and whose sales or distribution are not subject to extreme fluctuation - all recognize that the marketing of sludge is beneficial to the extent that it reduces disposal costs and/or recycles sludge so as to benefit the environment. We know of no case where an agency has continued to produce and market a sludge-based product if it expected the revenue from that operation to cover the full costs of processing and marketing the product.

Private contractors who have attempted to process and market the sludge as it comes from the wastewater treatment process have, in most cases, found the operation to be unprofitable. The private contractors who have been successful tend to fall into two categories. The first group have been paid to take the sludge as it comes from the wastewater treatment process and then further process it into a marketable product. The other successful model is the private operators who obtain or buy sludge products, such as composted material, from public agencies.

The products have been treated beyond what would have been required for wastewater treatment by the public agency in order to make them more marketable. In all such cases, the price paid by the private contractor for the material received is less than the cost to the agency of producing that material.

B. CONSISTENCY OF QUALITY AND MARKET CONTROL

The quality and form of the sludge-based product that can be successfully marketed must meet the unique requirements of the particular market that absorbs it. The experience of successful sludge marketing operations suggests that the quality of a sludge product must also be relatively consistent to be successfully marketed over a period of time. This generalization will be all the more true once some version of the "Minimum Standards for the Safe Handling and Disposal or Reclamation of Wastewater Treatment Plant Solids" currently being developed by the State Health Department is implemented. The history of unsuccessful sludge marketing operations contains many examples of discontinued marketing efforts attributable to user dissatisfaction because of variable product quality. For example, one contractor marketing a sludge product to golf courses lost his market after delivering several batches of soil amender because it contained unsightly materials that were visible to golfers, according to William B. Davis, Environmentalist/Horticulturist, University of California, Davis.

To some degree, all successful sludge marketing operations have been able to exercise some control over their markets. In some cases, this control has been accomplished by establishing a recognized brand name for the sludge products. A portion of the market could then be controlled by developing a preference for and loyalty toward this particular brand among the consumer group. In other cases, the successful sludge marketing operation controls a market by being the only supplier of a sludge-based product within the local market area. If, however, competition between nondistinguishable sludge-based products occurs, the results have historically been disastrous. For example, when the City of Los Angeles began to market its sludge-based soil amender in the 1950's in competition with the sludge marketing operation that had previously existed in San Diego, the price that San Diego could obtain for its product dropped from $17 to $3 per dry ton in a short period of time, according to Jack Betz, Director, Bureau of Sanitation, City of Los Angeles.

C. THE MESH BETWEEN PRODUCT, MARKETING APPROACH AND THE PARTICULAR SUBMARKET BEING SERVED

We have found no examples of successful sludge marketing operations that have attempted to serve all of the markets that could potentially utilize a sludge-based product. In this context, markets are groups of potential buyers or users with reasonably homogeneous motivations for taking or buying the sludge-based material. Whether by planning and design or by trial and error, all of the successful sludge marketing operations that we have identified operate with products and marketing approaches that are pinpointed to specific user groups. Generally these user groups can be categorized into three types of markets: agricultural users, professional or specialty markets, and the home and garden market. The marketing factors that existing and historic sludge marketing operations suggest as being most significant to the success or failure of reuse operations catering to these markets are discussed in the following paragraphs.

1. The Agricultural Market

If we were limited in our search for examples of reuse operations in agricultural markets to those cases where the farmers or growers actually paid for the sludge product applied to their lands, we would have had very few examples of successful sludge marketing operations. With a few exceptions, such as the purchase of sludge-based soil amenders for use on Florida orange groves, farm users of sludge-based material tend to be takers rather than buyers. One reason for this pattern is that sludge-based products tend to have relatively low levels of nitrogen, a key soil nutrient. Sludge-based products rarely contain more than 6% or 7% nitrogen, while inorganic chemical fertilizers can contain as much as 44% nitrogen. The applied cost of sludge-based materials is, therefore, rarely cost-effective in competition with inorganic fertilizers for agricultural use unless the material is provided at a very low cost with transportation subsidized. Some examples of successful sludge reuse by the agricultural market have involved the application of liquid or dry sludge to farm lands by wastewater treatment agencies.

The experience of those who have marketed or successfully given away sludge to agricultural users suggests the importance of carefully identifying the benefits that sludge can provide when used on specific types of soils for the growing of particular types of crops. Data from agricultural experimentation must be provided to farmers and those that advise them, such as agricultural extension agencies, if large-scale farm use is to be engendered. Because farming involves a large number of risks, farmers are hesitant to utilize unproven and untested new techniques or products unless they can be assured that such use will not impose additional risks upon them.

The amount of sludge that can potentially be taken by the agricultural market is very large. The historic approaches that seem the most successful, though, indicate that this market will never be able to pay the full significant cost of processing the sludge and transporting it to agricultural lands. Historic experiences also suggest that factual and substantiated information relating to the direct benefits of sludge utilization must be provided to the farmer. Specialty agricultural markets, such as nurseries and flower growers, may constitute unique submarkets for sludge-based products within the general agricultural market. We have not been able to find enough examples of historic attempts to market to these groups to reach any firm conclusions on such a possibility.

2. The Professional or Specialty Market

Potential sludge users within this market include landscape contractors, agencies concerned with the provision and maintenance of public open and recreational space (such as park districts and highway departments), and private operators of recreational open space (such as golf course greenskeepers). An important marketing factor that has affected the success of those who sought to sell to this market is the relationship between the price of the sludge-based product and substitutable soil amendments such as wood-based materials. Typically, marketing efforts to these users have been successful when a sludge-based product of consistent quality has been made available at a price that is equal to or less than the unit cost of other organic materials, such as fir bark. Interviews with contractors who have successfully sold sludge-based products to this market have led us to conclude that penetration of the market requires educational efforts that lead landscape architects and others who write specifications for landscaping projects to call for the use of sludge-based materials. Another important factor in this market is the availability of the material at points that minimize the cost of transportation to the user.

3. The Home and Garden Market

While the experience of existing and past reuse operations suggests that home gardeners will pay more for sludge-based soil amendments than any other market, selling a sludge-based product to this market requires an extremely sophisticated product and marketing strategy. Agencies and contractors who have successfully disposed of sludge-based products to such markets have either given the product away or developed and marketed branded products that were carefully designed, advertised and distributed to conform to the tastes and attitudes of home gardeners. Competing producers of soil amendments and fertilizers have effectively utilized newspaper, radio, television and point-of-sale advertising. Therefore, successful marketers of sludge-based products have usually undertaken some form of advertising in order to encourage consumer loyalty to their brand. Successful distribution has taken place through standard retailing channels when the product has been sold or through specially set-up distribution centers when the product has been given away to this market.

SECTION III

CURRENT SLUDGE MARKETING OPERATIONS IN SOUTHERN CALIFORNIA

A. COUNTY SANITATION DISTRICT #1 OF ORANGE COUNTY

Digested sewage sludge is currently being taken from the district's treatment plants #1 and #2, located in Fountain Valley and Huntington Beach, by the Golden West Fertilizer Company. In 1976 the output amounted to about 170 cubic yards of sludge per day and was estimated to grow to 190 cubic yards per day in 1977. Golden West is further processing the sludge at their facility in Irvine. Contractors are currently being paid $2.75 per cubic yard to take the material from the district. After processing, the material is being sold to the specialty market in bulk as well as being bagged for sale by other distributors to the retail home and garden market. We understand that the sludge-based material is frequently mixed with other products before being marketed to either the specialty or the home and garden market. Some of the processed sludge, frequently after being mixed with other materials, is also being utilized by some local horticultural operations, particularly nurseries. In all likelihood, the contractor will probably have to raise the price that he charges the district to take this material in the future. His costs are particularly likely to go up if health and safety regulations currently under consideration require more careful and costly monitoring and reporting of sludge processing procedures.

B. THE LOS ANGELES COUNTY SANITATION DISTRICTS

The LACSD joint plant in Carson produces a compost that is marketed by the Kellogg Supply Company.

Kellogg packages and distributes the composted sludge alone and in combination with other materials such as wood and peat for use as a soil amendment, top dressing, and indoor and outdoor planting mixes. Until 1950, Kellogg marketed its sludge-based products exclusively to farms. Today, Kellogg's customer base consists of retail nurseries, wholesale nursery product growers, institutional users, landscape contractors and retail outlets. The retail market accounts for 80% of Kellogg's business, the specialty market for 18%, and wholesale markets and farms for 2%.

Currently, Kellogg is processing and distributing approximately 30,000 tons of composted sludge and sludge-based products annually. Kellogg's arrangement with the Los Angeles County Sanitation District (LACSD) is to receive approximately 30,000 to 50,000 tons of primary/digested/composted sludge for a guaranteed annual minimum payment of $25,000 plus a percentage of gross sales, ranging from 3.3 to 1.1%. In 1975, LACSD received over $99,000 from the Kellogg Supply Company, whose gross sales that year exceeded $5 million. The demand for Kellogg products is currently outstripping supply by at least 25%.

SECTION IV

PAST REUSE OPERATIONS IN SOUTHERN CALIFORNIA

In 1950, the City of Los Angeles constructed a new wastewater treatment facility at Hyperion,which included a high-rate activated sludge process. Anaerobically digested primary sludge mixed with waste activated sludge was vacuum-filtered and heat-dried to produce a dry end-product in a powdered form. The dry sludge product was marketed as a soil amendment product. A very noncomprehensive marketing study conducted at the time suggested that a marketable soil amendment product could be made and sold for between $6 and $10 a dry ton. Based on this brief analysis, the City expected to come out even on the sludge processing operation.

The plant was in operation from 1950 to 1960. The cost of producing the product fluctuated between a low of about $15 a dry ton and a high of approximately $21 to $22 a dry ton. The plant produced approximately 100 tons per day and, in the best periods of operation, sold about 50 tons per day through the Wilbur Ellis Company, who served as a jobber. The Ellis Company purchased the material in bulk for $3 per ton, or in 80-pound paper bags for $7 per ton. The company sold the product to the professional and specialty market and to agricultural users in the San Joaquin Valley.

The approximately 50 tons per day of product that were not saleable were distributed free to park districts in southern California cities and to the El Toro Marine Corps base. Public users were required to pick up the material and haul it away. Very little of the product was distributed to the home and garden market. However, the city's free distribution of about 50 tons per day to park districts and others had an impact upon the marketing effort that had previously been started by the City of San Diego. As Los Angeles began to distribute the sludge-based product, the price that San Diego was able to get dropped from $17 per ton to $3 per dry ton.

A major marketing problem was related to the form of the material produced. It was a lightweight, dusty material and, therefore, difficult to apply in water. To overcome this problem, the City of Los Angeles began to pelletize the material. Unfortunately, the pelletizing process added approximately $8 to $9 per dry ton to the cost of production. The city attempted to pass this cost on by increasing the price to the jobbers. The result was that they priced the product out of the specialty market and were unable to continue the operation. Furthermore, it became clear that disposal through other means was considerably more economical at that time.

SECTION V

SAMPLES OF MARKETING OPERATIONS OUTSIDE THE SOUTHERN CALIFORNIA AREA

We have categorized some of the numerous examples of past and present operations in terms of the kinds of products produced.

A. HEAT-DRIED SLUDGE

1. Amarillo, Texas

The city air dries approximately 2,000 dry tons of sludge per year on land and on sand beds. In the past, the air-dried sludge was sold to a private contractor who heat dried the sludge and distributed the product to tobacco farms in Kentucky and Tennessee. This was a typical combined operation where the city sold the air-dried sludge to a private operator for $1.00 per ton which was less than the cost to the city of handling the sludge, but less than the cost of other means of sludge disposal. In this case, the city was not making a profit but was able to dispose of the sludge at a reasonable cost. This is probably a basic contributing factor to the past success of this operation, which functioned from 1960 to 1977.

The city is now negotiating with a new contractor which will probably pulverize the air-dried sludge and market it on a retail basis to the public. The city expects to begin land spreading liquid sludge within a year, but will still air dry about 25% of the sludge.

The sludge is produced by two plants of 12 and 5 mgd capacity serving a population of approximately 150,000. The sludge is anaerobically digested primary plus waste activated.

2. Jefferson County, Alabama (Birmingham)

The county air dries a portion of the sludge and flash dries the rest. The flash-dried product is bagged and marketed by the county under the name of "Grow-Go" for $1.00 per 50-pound bag and the air-dried product is sold in bulk for $1.50 per cubic yard. This operation has been active since 1953; however, the private company who used to operate it failed, so the county has taken over the total operation. The dried product is distributed to Kentucky, Florida and Mississippi for various uses including citrus orchards. The percentage of sludge which is flash dried is decreasing because of costs. The flash-dried product costs approximately $15 to $20 per ton to produce, not including bagging and handling, and the sales price is $40 per ton. Considering all costs, it is doubtful whether the city makes a profit on this operation; but again, it is able to produce and market a useful product at a very reasonable sludge disposal cost. The sludge is produced at the 40 mgd Village Creek (Pratt City) Plant and is anaerobically digested primary sludge. The plant serves a population of 220,000.

3. Corpus Christi, Texas

This city has air dried sludge from 1936 to 1955 and has heat dried in a rotary kiln from 1955 to present. The dried product is sold for $2.00 per 80-pound bag or for $10 per cubic yard at the plant. Demand exceeds the supply. The cost of production is reportedly $3.20 per 80-pounds or approximately $50 to $60 per cubic yard.

Because of high costs, the city is considering abandoning this operation in favor of land application of wet sludge.

It is possible the city could receive higher revenue for the product through a planned promotional program; however, the product contains approximately 2.5% nitrogen. Based on 50% availability over three years, the cost of nitrogen is $2.00 per pound in the bagged and $ .55 per pound in bulk. Sophisticated buyers will probably not pay much higher prices for this product.

The sludge is primary plus waste activated from two plants; the 9-mgd OSO plant and the 6.5-mgd Broadway plant. These plants serve a population of approximately 150,000.

4. Houston, Texas

The City of Houston flash dries approximately 25,000 dry tons of activated sludge per year and sells it under the trade name "Hou-Actonite". The marketing is through a broker. Some of the material is sold to fertilizer manufacturers who blend it with other materials to produce a balanced fertilizer, but most is marketed in Florida for use in citrus orchards. This operation has been active since 1950. The city, in 1975, received approximately $21 per ton for the dried product. The costs of production are not known, but are likely higher than the revenue received.

The sludge is collected from a number of plants (total capacity of 250 mgd) and is dried at two facilities. Other drying facilities are planned or under construction.

5. Milwaukee, Wisconsin

Milwaukee has been producing kiln-dried mixture of primary and waste activated sludge since 1926. The product is marketed by brokers to a number of markets, but primarily golf courses and other turf users. The product is marketed as a fertilizer under the name "Milorganite" and the city receives approximately $65 per ton at the plant. Reported costs of production are $85 to $90 per ton. Approximately 70,000 dry tons of waste activated sludge per year are dried. The nitrogen content is approximately 6% and the selling price is approximately $1 per pound of nitrogen, assuming 50% is available over three years. "Milorganite" has been heavily promoted and advertised.

The sludge is produced at the 200-mgd Jones Island plant and is essentially waste-activated. The plant serves a population equivalent of approximately 150,000.

6. Schenectady, New York

This city heat dried digested primary sludge and marketed it as "Orgro" from 1960 to 1973. Operations ceased in 1973 because of high costs and low demand. The product was sold for $1 per 65-pound bag and contained about 2% nitrogen. The cost of production was reportedly greater than $2 per 65-pound bag. Demand was not high, but was adequate to market 100% of production. No advertising was used and the people who used the product reportedly liked it.

The city recently added secondary treatment and has implemented a more cost-effective sludge program which does not include heat drying.

The plant serves a population of approximately 77,000.

7. Other

There are additional examples of heat-dried sludge product production and marketing, but only limited information is available.

B. AIR-DRIED SLUDGE

1. Mobile, Alabama

Mobile is able to dispose of 100% of their sludge by air drying and marketing it to local users who pick it up at the plant.

The sludge is used for various soil conditioning applications by the various users. Output is approximately 25,000 to 30,000 cubic feet per month of dried sludge. The city has been marketing this product free to users since 1948.

The anaerobically digested primary-plus-waste-activated sludge from four treatment plants in Mobile is air dried and distributed. The total treatment capacity of the plants is 25 mgd and the plants serve a population of approximately 220,000.

2. Oklahoma City, Oklahoma

The city dries approximately 1 mgd (million gallons/day) of 6% anaerobically digested sludge per day. About 90% of the dried sludge is landfilled and 10% is provided free to users who pick it up. The sludge is used for various soil conditioning applications by the users. The city has not pushed the marketing because the State Health Department has not approved the use of the dried sludge.

The sludge is produced at four main plants and is anaerobically digested primary-plus-waste-activated. A population of approximately 500,000 is served.

3. Oshkosh, Wisconsin

The city air dried a portion of their anaerobically digested sludge production and made it available to users for $.25 per bushel or $2 per cubic yard. The sludge was used for various soil conditioning applications. The rest of the sludge was trucked to landfill. The city was not able to distribute the dried sludge, stopped the drying and marketing in 1972, and started up a heat treatment process in 1976.

The plant serves a population of approximately 40,000 to 50,000.

4. Fort Worth, Texas

The city air dries the anaerobically digested primary-plus-waste activated sludge from the 45 mgd Village Creek plant. This plant serves a population of approximately 400,000. The city has no formal marketing program, but allows individuals to obtain the dried sludge at the plant.

The primary markets for the dried sludge are the City Park Department, the Tarrant County Water Control and Irrigation District, and the Texas State Highway Department. During the past three years, demand has been greater than supply. Tarrant County was unable to obtain all that they needed. Other governmental agencies use sludge, but on a truckload basis. They report they are not only pleased with the product, but are enthusiastic. It is anticipated that a composted sludge would be similarly accepted.

It appears that all of the sludge in the Fort Worth area could be disposed of in composted form at nominal income to the city. It appears that the primary market would be governmental agencies.

C. COMPOST OR COMPOST-LIKE PRODUCTS

Wastewater sludge compost is produced and marketed at three major locations outside California: Chicago, Illinois; Beltsville, Maryland; and Bangor, Maine.

A portion of the Blue Plains Wastewater Treatment Plant sludge is composted at Beltsville (approximately 10%) as a demonstration composting project operated jointly by the Maryland Environmental Services and the USDA, Agricultural Research Service.

Compost from Beltsville is distributed primarily to public agencies who must pick up the compost at the site. The compost is provided free of charge on this basis. Beltsville will provide compost to private users under special agreement at nominal price. Demand exceeds supply. The cost of production of the compost, excluding hauling, is on the order of $40 per cubic yard of production, although it is difficult to separate production costs from research costs in some cases.

Chicago is distributing a compost-like product from an old sludge landfill. This product, to date, has been given primarily to private citizens. The product was named Nu-Earth in 1974 and simultaneously written up favorably in a Chicago newspaper and orders began to exceed the delivery capability. Other classes of users have not been promoted because the present demand cannot be supplied. Chicago has a large backlog of unfilled requests and reports only a couple of user complaints relating to odors out of the many served. The compost is delivered in 28-cubic yard truckloads and, in addition, approximately 60 neighborhood pick-up points have been established and are kept stocked. There is no charge for the compost, even when delivered.

The City of Bangor, Maine has been composting undigested primary wastewater sludge since early 1975. To date, only a small quantity has been marketed and the rest has been stockpiled. The plan is to market to other city departments (such as parks) at a transfer cost of approximately $3 per cubic yard. The cost of production is estimated to be $5 to $10 per cubic yard. No marketing conclusions can be drawn from the Bangor operation at this time except that it appears that a market is available for use of the product and that costs of production will exceed revenue.

The Bangor plant is a 5-mgd primary treatment facility which serves a population of 45,000.

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